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ABSTRACT

Current issues in educational communications and technology are addressed in this collection of 48 papers, in which research reports predominate. Topics discussed include factors related to the learner, e.g., field dependence/independence, learning strategies, information processing, spatial ability, cognitive style, and cognitive strategies. Presentation format and media and stimulus characteristics are also addressed, including illustration types, graphics in courseware design, encoding specificity, text layout variables, feedback, and synthesizing strategies. Several papers examine innovative educational media such as videodiscs, compressed speech audiotapes, videotapes, and microcomputers. Additional papers discuss the use of media in persuasive messages, the design of instructional visuals, the use of video to study cognition, the relationship of film theory to instructional television, visualization, naturalistic inquiry and case studies as research methods, electronic books, and drill and practice. References and data tables are included with many papers. Cumulative indexes of authors and descriptors covering the first seven volumes of conference proceedings (1979-1985) for the Research and Theory Division of the Association for Educational Communications and Technology are included. (LMM).

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PROCEEDINGS OF SELECTED RESEARCH PAPER PRESENTATIONS

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PREFACE

For the seventh year, the Research and Theory Division of the Association for Educational Communications and Technology (AECT) is publishing these Proceedings. Papers published in this volume were presented at the national AECT Convention in Anaheim, CA. A limited quantity of this volume were printed and sold. It is also available on microfiche through the Educational Resources Information Clearinghouse (ERIC) system.

REFEREEING PROCESS: All Research and Theory Division papers selected for presentation at the AECT Convention and included in this Proceedings were subjected to a rigorous blind reviewing process. Proposals were submitted to Dr. Rhonda Robinson of Northern Illinois University, who coordinated the review process. All references to author were removed from proposals before they were submitted to referees for review. Approximately sixty percent of the manuscripts submitted for consideration were selected for presentation at the Convention and for publication in these Proceedings. The papers contained in this document represent some of the most current thinking in educational communications and technology.

This volume contains two cumulative indexes covering the first seven volumes, 1979-85. The first is an author index. The second is a descriptor index. The two indexes will be updated in future editions of this Proceedings.

M. R. Simonson
Editor

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Student Incentive Preferences in a Competency-Based Remedial Algebra Course

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Abstract

"Lack of effort" is a major reason for non-success among students in remedial mathematics. It has been theorized that the presence of a reward, or incentive, may increase motivation in this learner group. The present study was designed to survey student attitudes toward incentive options in a competency-based remedial algebra course. Four hundred twenty-one students completed a two-part survey form. "Course credit to count toward graduation" received an overwhelmingly favorable reaction. Of the ten incentives surveyed, only two others received favorable responses: "preference during course registration" and "release from required class attendance." The others were not considered viable incentive options.

Student Incentive Preferences in a Competency-Based Remedial Algebra Course

Sparking student interest in learning is a prime concern of instructors and administrators of remedial mathematics programs in post-secondary education. According to a survey of remedial service administrators at two-year colleges, "lack of effort" was considered the major obstacle to learning among low-achieving students, while "low intelligence" was rated the least likely reason for non-success among seven possible causes (Cross, 1971). Motivation is a particularly important factor among "high risk" students whose backgrounds often require careful reconstruction of learning patterns (Greising, 1969).

The recent proliferation of remedial programs has brought vast numbers of disinterested, unmotivated students to college mathematics departments. Over 75 percent of all four-year institutions and 95 percent of all community colleges now have some kind of preparatory math program (Lindberg, 1977). In fact, Steen (1978) notes that "the fastest growing subject in freshman college mathematics is grade school arithmetic."

Kerr and Lang (1981) classify remedial algebra students into four general categories:

1. A-level students who are active, self-motivated, and successful;
2. students who are passive, unmotivated, disaffected in class, and unwilling to do any more work than necessary, but are able to pass at a minimal level;
3. active, motivated students who attempt to learn but do not achieve success because of math anxiety or other factors; and

4. passive, unmotivated, indifferent students who make little effort and do not succeed.

According to Kerr and Lang, groups 1 and 3 put forth a sincere attempt to learn the material, while groups 2 and 4 have the capability to learn but are not compelled to try. These are the students for whom incentives may be necessary to motivate them to reach their learning potential.

Although the concept that performance can be improved by increasing motivation is not universally accepted (Klingelhofer & Hollander, 1973), a tenet of expectancy theory states that students can be inspired to increase their effort if a reward is likely to follow successful task performance (Slavin, 1977). Moreover, studies by Atkinson (1958) suggest that the more attractive the reward, the more vigorous an effort is likely to be expended by the learner. Greising (1969) points out that the need for immediate rewards, as opposed to the long-range incentive of degree achievement, is much more acute for high risk learners.

The purpose of a reward is to restructure the student's environment so that achievement of educational goals is more compelling. The literature on incentives seems to confirm that the use of appropriate rewards may indeed have a significant effect on learning (Lipe & Jung, 1971).

The incentive options available for use by college faculty members appear to have received little attention from researchers. Bebeau, Eubanks, and Sullivan (1977) tested preferences for 10 incentives commonly offered in college courses, using the paired comparison method with psychology students. "Release from final exam" was the overwhelming favorite, followed by "points toward class grade." "No reward" and "assisting the instructor as proctor" were the least preferred. Bebeau and Sullivan (1982) then replicated the study with upper-division education majors and obtained nearly identical results. "Release from final exam" was again the most preferred option, with "positive comments from instructor" ranked second.

Several of the incentives tested by Bebeau and her colleagues, including the two most highly preferred in the 1977 study, are not appropriate in a competency-based program, where advancement depends upon achievement of specific criteria. The present study was designed to examine student preferences for rewards that are consistent with the competency-based approach.

Method

Subjects

Subjects were 421 students enrolled in a remedial algebra course at Iowa State University. In an attempt to facilitate student progress and improve quality control, the course was converted in 1982 to a modular, competency-based format with individual module prescriptions for each student determined by performance on a diagnostic test.

Instruments

Incentives included in the survey were carefully screened to meet two criteria. First, each incentive must be under the direct control of the instructor, department, or university, rather than under the control of the student. For example, "personal expectations," which is a powerful motivator for students with high levels of achievement motivation, cannot easily be manipulated by the instructor and therefore is impractical as an extrinsic reward. Second, the incentive must be performance-contingent. In the case of a competency-based course, it must be available to all students who meet the required criterion levels and not available to those who do not.

Three of the ten incentives examined by Bebeau and Sullivan (1982) were considered appropriate for this study: "release from required class attendance," "verbal praise from the instructor," and "no reward at all." Those deleted included "course-related field trips," "discussion with authority," and "recognition in publications," which did not seem suitable for a remedial mathematics course.

Course credit is an important issue that the investigator~~s~~ felt should be on the list. Many institutions, including Iowa State University, do not award academic credit for remedial mathematics courses.

The list of incentives selected were reviewed and validated by colleagues of the investigator. Included were:

1. Awarding of course credit to count toward graduation.
2. Awarding of course credit not to count toward graduation.
3. Preference during course registration.
4. Release from required class attendance.
5. Opportunity to serve as tutor.
6. Posting of names of those who achieve high module scores.

7. Verbal praise from the instructor.

8. Reporting of module success to advisor.

9. Reporting of module success to parents.

10. No reward at all.

The survey instrument took the form of a two-part incentive preference scale. Part I was based on Atkinson's (1958) theory that the rewards perceived to be the most attractive to students are likely to be the most effective as incentives. Therefore, subjects were asked to rate each incentive independently on a seven-point, Likert-type scale with "very desirable" at one extreme and "very undesirable" at the other.

Part II employed the paired comparison method described by Edwards (1957). Each option was paired with every other incentive to form a list of 45 pairs. The presentation sequence was selected at random. Students were asked to consider each incentive in each pair and mark the one they perceived to be the more desirable.

Procedure

The survey was administered during the first fifteen minutes of a regularly scheduled class period in the fifth week of fall semester classes. All sixteen sections of the course participated.

Subjects were given the questionnaire in printed format. Instructions were typed at the beginning of each part and also were provided orally. Complete anonymity was guaranteed.

Results

Paired Comparisons

The paired comparison data were analyzed by tabulating the ten incentives in rows and columns. Percentages were entered by column to indicate the proportion of student preference for that incentive over the incentive listed in each row (Edwards, 1957). The results appear in Table 1.

Insert Table 1 about here

"Course credit to count toward graduation" was the overwhelming choice as most desirable incentive. Ninety-one percent of the students preferred graduation credit over all other options. "Preference during course registration" and "release from required class attendance" were also preferred by large majorities over other incentive options. In the rank ordering, "no reward at all" finished last, barely behind a reward receiving surprisingly little support, "course credit not to count toward graduation."

The percentages for each column were summed and converted to scale values reflecting deviation units above the least preferred option, according to the Case V Model of Edwards (1957). This procedure presents an accurate perspective of student preference for each incentive in comparison with the other alternatives. The degree of preference for "course credit to count toward graduation" was illustrated by its scale value, 2.178, more than two deviation units above the least preferred choice. Scale values of 1.567 and 1.162 were calculated for "preference during course registration" and "release from required class attendance," respectively. None of the other seven rewards had scale values more than one deviation unit above the lowest ranked option.

The validity of the results is dependent upon the consistency of subject responses. According to logic, if Option 1 is preferred over Option 2 and Option 2 over Option 3, then Option 1 should also be favored over Option 3. If Option 3 is preferred over Option 1, the result is what Kendall (1948) describes as a circular triad, an inconsistency. Ideally, the number of circular triads in any set of paired comparison responses should be minimized.

Kendall developed a formula for the coefficient of consistency (zeta) that incorporates the number of circular triads and provides a measure of within-subject consistency of ratings (Edwards, 1957). The zeta value is determined individually for each subject and evaluated according to the χ^2 distribution. It can be calculated from Kendall's formula that with ten stimuli being compared (df = 20), a zeta score of approximately .45 is required for statistical significance at the .05 level and .57 for significance at the .01 level. Zeta scores of .45 or higher were obtained for 98 percent of the subjects, and 96 percent achieved zeta scores of .57 or higher. In fact, 72 percent had zeta scores of .90 or higher, indicating an extremely high rate of consistency.

Since subjects may be perfectly consistent in their responses yet not agree with each other, Kendall also developed a statistic designated u, the coefficient of agreement (Edwards, 1957). A value of 1 is obtained when there is perfect agreement among the judges. The minimum possible value of *u* is a function of the number of judges but can never be less than -1. Any positive value of *u* indicates some degree of agreement. The coefficient of agreement obtained was .3438. Using Kendall's test of significance for *u*, which is also tested against the χ^2 distribution, a χ^2 value of 6574.01 was obtained, df = 45, $p < .001$, confirming a highly significant degree of agreement among raters.

Attitude Scale

While the calculation of scale values according to Edwards' Case V Model is one means of determining the strength of subject feelings toward any one option, another technique is the evaluation of each stimulus independently using a Likert-type rating scale. The results of part I of the questionnaire may be found in Table 2. The rank order obtained using this method was nearly identical to that indicated in Table 1, with only the seventh and eighth choices reversed.

Insert Table 2 about here

Table 2 also provides the percentage of subjects responding favorably (1-3), indifferently (4), and unfavorably (5-7) to each item. The enthusiasm for "course credit to count toward graduation" is confirmed by Table 2. Ninety-three percent of the subjects responded positively to this incentive, and the mean score of 1.71 indicated that the majority of responses were highly positive.

"Preference during course registration" was again a clear-cut second choice, with 67 percent in favor and just 13 percent considering it undesirable. Only one other incentive listed was deemed desirable by as many as 40 percent of the subjects. Nearly twice as many favored "release from required class attendance" as opposed it, 53 percent to 27 percent, but the mean score of 3.57 indicated few extremely positive ratings and only moderate interest overall.

A Pearson product-moment correlation was calculated to determine the degree of consistency between the scale values from the paired comparisons and the mean rating scores from the seven-point attitude scale. The resulting r of .98 ($p < .001$) confirmed that subjects marked both parts of the questionnaire consistently.

Discussion

If it is true that high risk students need a reward structure to increase their incentive to learn (Greising, 1969) and that the more desirable the reward, the stronger its incentive value (Atkinson, 1958), it appears that few of the rewards consistent with a competency-based system may be effective with students in remedial mathematics. Only three of the potential rewards evaluated in this study aroused much student interest.

It should not be surprising that course credit counting toward graduation was held in such high regard. The course at Iowa State University requires just as much time and effort as freshman-level courses. Mathematics departments typically resist offering academic credit for remedial algebra because incoming students are expected to have learned this material in high school. However, Cross (1976) feels that degree credit should be granted for remedial courses. She points out that the students most in need of remediation are those who have found little meaning and satisfaction in learning. For them to complete successfully what may be (for them) a demanding course only to be denied academic credit may reinforce the hollow feeling they have about education. Cross notes that credit is the most significant immediate and tangible reward that colleges and universities have to offer.

Response to "course credit not to count toward graduation" was unexpected. It had been hypothesized that graduation credit would be highly regarded but that academic credit of any kind would be a viable incentive. Two participating classes were given informal post-hoc interviews to solicit their rationale for responding as they did. Students resented having to take courses that did not count toward their graduation requirements, regardless of whether academic credit was offered. Moreover, they did not want non-degree credit courses to influence their grade-point averages.

"Preference during course registration" appears to be an incentive that rates serious consideration. Competition for seats in high-demand courses is keen at many institutions, and large numbers of students, particularly underclassmen, are often "closed out." The possibility of obtaining "head of the line" privileges at preregistration if a remedial course is completed successfully may be a powerful incentive. Since a competency-based system often increases the number of incomplete grades awarded, registrars may be willing to grant registration privileges in a trade for more passing grades and fewer incompletes to be processed.

Moderate support was given to "reporting of module success to advisors." Most students enrolled in the program are freshmen, many of them admitted conditionally because of low high school grades, and the idea of confirming their progress by sending notes to their advisors may have been appealing to this group. However, this incentive had the highest percentage of "no opinion" responses. (See Table 2.)

While "verbal praise from the instructor" received the fourth highest percentage of positive responses on the seven-point scale (see Table 2), the mean score of 4.03 was considerably lower than that obtained for the same incentive by Bebeau, Edwards, and Sullivan (1977), 2.78, and Bebeau and Sullivan (1982), 2.69. The differences may well have been a function of the courses in which the data were collected and the attitudes of the students surveyed. It supported Cross's (1976) belief that tangible rewards seem to be more effective for students in remedial courses.

The results of this study provide additional insight into the incentive preferences of students enrolled in a remedial mathematics program. The key issue yet to be resolved is whether implementation of a system using an incentive program would actually have a positive effect in improving student performance.

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Table 1

Student Preferences for Incentives

When Presented in Pairs, by Percent

		Scale Value	1	2	3	4	5	6	7	8	9	10
1.	Course credit -- counts toward graduation	2.178	--	08	14	17	07	06	04	10	06	06
2.	Course credit -- not to count toward graduation	0.137	92	--	86	75	68	68	62	75	69	55
3.	Preference during pre-registration	1.567	86	14	--	43	17	10	15	17	11	07
4.	Release from required class attendance	1.162	83	25	57	--	27	25	27	33	28	15
5.	Opportunity to serve as tutor	0.420	93	32	83	73	--	56	65	60	55	37
6.	Posting of name of high scorers	0.460	94	32	90	75	44	--	51	67	51	29
7.	Verbal praise from instructor	0.513	96	38	85	73	35	49	--	64	51	24
8.	Reporting of scores to advisors	0.787	90	25	83	67	40	33	36	--	42	19
9.	Reporting of scores to parents	0.516	94	31	89	72	45	49	49	58	--	29
10.	No reward at all	0.000	94	45	93	85	63	71	76	81	71	--
	Mean percentage		91	28	76	64	38	41	43	52	42	25
	Rank order		1	9	2	3	8	7	5	4	6	10

Table 2

Student Preferences for Incentives

Considered Independently, by Percent

Rank Order	Incentive	For	Indif	Against	$\bar{X}$
1	Course credit to count toward graduation	93	04	03	1.71
2	Preference during course registration	67	20	13	2.87
3	Release from required class attendance	53	20	27	3.57
4	Reporting of modules success to advisor	36	35	29	3.90
5	Verbal praise from instructor	39	28	33	4.03
6	Reporting of module success to parents	30	27	43	4.40
7	Posting of names of those with high scores	26	24	50	4.57
8	Opportunity to serve as tutor	24	23	53	4.66
9	Course credit *not* to count toward graduation	26	09	65	5.04
10	No reward at all	10	13	77	5.74

The Instructional Graphics Checklist:[1]
A Look at the Design of Graphics in Courseware

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An overemphasis on verbal instruction has been blamed in part for the current crisis in education as the preponderence of new terminology in textbooks exceeds the learner's ability to absorb new vocabulary. For example, secondary textbooks in science were found to present 10-20 new terms per page and well over 10,000 new terms per book (Yager, 1983). In contrast, science textbooks were found to have only 1-2 instructional pictures per page (Brody, 1982-83). Yet there is convincing evidence that relevant pictures can significantly facilitate learning for both adults (Alesandrini, 1984a) and children (Pressley, 1977). Microcomputer-based instruction offers the potential of presenting information in a pictorial or graphic form rather than in an all-verbal format, yet this potential has not been fully explored or developed. A recent survey of 60 commercial CAI lessons found that most of the lessons used few or no graphics to communicate the main points (Alesandrini, 1984b). The Instructional Graphics Checklist was developed to reflect the research findings about pictures in instruction and to serve as an informal evaluation instrument for educators to use in determining whether a CAI lesson is making appropriate use of graphics in instruction.

Part One: Use of Graphics

The incidence of graphics in CAI lessons is difficult to quantify because the number of graphics shown depends on the length of the lesson. For purposes of the checklist, the use of graphics in the lesson was quantified by the percentage of total lesson time that involved display of graphics on the display screen. The four categories include: no graphics displayed, graphics displayed at least 1/4 of the time, 1/2 of the time, and more than 1/2 of the time. Research on pictures generally supports the use of graphics (Alesandrini, 1984a;1982;in press). However, the studies on picture effects vary widely on the basis of frequency of picture incidence. For example, researchers report using one picture to illustrate each concept or sentence (Guttmann, Levin, & Pressley, 1977), one picture to illustrate each paragraph (DeRose, 1976), several pictures per lesson (Vernon, 1954), or one picture per lesson (Wardle, 1977). But since studies generally show that pictures facilitate recall of information portrayed in the picture, the checklist reflects the notion that a higher incidence of pictures is desirable. It should also be noted that most of the picture research is based on studies that did NOT involve computer-based instruction. However, several studies confirm the picture effect for CAI (Alesandrini & Rigney, 1981; Rigney & Lutz, 1976).

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[1] Presented at the annual meeting of the Association for Educational Communications and Technology, January 1985, Anaheim, CA.

Part Two: Relevance of Graphics

It may seem intuitively obvious that graphics should be related to the topic of the CAI lesson yet any casual examination of current courseware usually reveals an abundance of irrelevant graphics. It is not surprising that research studies have shown that irrelevant or inaccurate pictures as well as those used only for embellishment can fail to facilitate memory and may even have adverse effects (Baker & Popham, 1969; Peeck, 1974). Of course, graphics do attract attention and can spark the learner's motivation. But in order to be truly effective, graphics in CAI should be relevant to the topic and content of the lesson. Finally, the graphics may also facilitate learning if they are used to give feedback after the learner responds. Again, it seems intuitively obvious that wrong responses should not be followed by "rewarding" graphics (although informative visual feedback after both correct and wrong answers can facilitate learning).

Part Three: Types of Graphics

Instructional pictures have been classified on the basis of how they convey meaning including representational, analogical, and abstract (orarbitrary) (Gropper, 1963;Knowlton, 1966). Research studies indicate that each of the three types facilitates learning (Alesandrini, 1984a; Levie & Lentz, 1982). Yet many CAI lessons may be using only the first type of graphics when pictures are used at all (Alesandrini, 1984b). (The terms "pictures" and "graphics" are used interchangeably in this paper.) The checklist reflects the fact that each of the three types may be used to either present information initially or give informative feedback after the learner responds to questions or problems.

Representational Graphics. Graphics that are representational have also been termed "realistic" (Knowlton, 1966) because the category refers to pictures that are isomorphic with the objects or topics that they represent. Graphics in this category may vary, however, on the basis of amount of realistic detail so the term "representational" is less confusing. In courseware, representational graphics include line drawings, shaded drawings, silhouettes, and realistic symbols.

Representational pictures can either portray information directly or indirectly. Tangible objects or concepts may be represented directly. However, it is not always obvious how to portray a concept that has no tangible existence. Although abstract concepts cannot be directly portrayed, they may be portrayed indirectly by showing their effects, results, instances, or exemplars (Gropper, 1963). It may be impossible to directly portray the topic of "heat", for example, but its effect on solids, liquids, and gasses may be shown via melting, boiling, and expansion of gas-filled objects, respectively. Another approach to illustrating abstract concepts representationally is to portray a concrete associate of the concept (Jones, 1983). Seasons of the year may be portrayed by showing the typical dress and activities of people during that season. Some educators have made up pseudo-examples that portray what the educator thinks the concept might look like if it were tangible (Cantu & Herron, 1978).

When graphics are used in courseware, they are typically representational. This type of graphics appeared in 40% of the math lessons surveyed, 71% of the science lessons, 25% of the CAI lessons in language arts, and 21% of the social studies lessons (Alesandrini, 1984b). Only in the area of math was another category of graphics more prevalent--namely, abstract graphics such as charts and graphs. In all areas except social studies lessons, representational graphics were used more often to present information than to give feedback despite the evidence that visual feedback can facilitate learning.

Analogical Graphics. Another category of graphics has been termed analogical because the concept or topic is conveyed by showing something else and implying a similarity. The benefit of this type of graphics is based on the assumption that new information will be better learned and remembered if it can be related to prior knowledge (Reigeluth, 1983; Wittrock, 1974; 1977). Studies show that this type of picture can facilitate learning (Alesandrini, 1984a). For example, visual analogies have been used to facilitate both learning (Mayer, 1975; Royer & Cable, 1976) and problem solving (Gick & Holyoak, 1983).

Of the 60 CBI packages surveyed, none made use of analogical graphics.

Educators should be concerned if they find a total lack of analogical graphics since theory and research support the value of analogical graphics in CAI. Verbal analogies have also proven facilitative and educators may want to look for the inclusion of verbal analogies in a CAI lesson if no visual analogies are present.

Abstract Graphics. The final category in the Checklist is abstract graphics also referred to as arbitrary or logical graphics. These visuals do not look like the things that they represent but are related abstractly or conceptually. Knowlton (1966) referred to this type of picture as "logical". Abstract graphics include graphs, flowcharts, networks, maps tree diagrams, and other schematized charts and diagrams. This category is very useful in structuring and organizing verbal text. Abstract graphics can be used to facilitate learning when no other type of picture is possible or feasible. Again, research results support the value of this category of graphics in instruction (Alesandrini, 1984a).

Although computers are well suited to the display of abstract graphics since this type of visual is relatively easy for the instructional designer to create via computer, few CAI lessons surveyed contained abstract graphics. Of the 60 CAI packages surveyed, only 13 (22%) used abstract graphics of any kind to present information. Twelve of the lessons used abstract graphics to provide informational feedback after the learner responded. Of the 13 lessons that used abstract graphics to present information, nine of the lessons were in the area of mathematics. None of the lessons in social studies used this type of visual. Yet flowcharts, organizational charts, tree diagrams, structural networks, and hierarchical maps have proven valuable in learning from text (Moore & Readence, 1983). It appears that CAI lessons could do much better in taking advantage of abstract graphics.

An Example Application of the Checklist

The Checklist was designed to provide the educator with some general guidelines for determining whether a CAI lesson is using instructional graphics appropriately and fully. It serves as an informal means of determining the instructional value of a CAI lesson based on its use of graphics. The Checklist was applied to two different CAI lessons that differed considerably in their use of graphics. For comparison purposes, the Checklist was quantified by scoring all items checked as one point except for items 1, 5, and 10. The latter three items are negative characteristics of a CAI lesson and, therefore, each detracted a point from the score. One reason the Checklist is described as "informal" is that there is yet no evidence regarding the relative contribution that each characteristic listed on the checklist makes to the effectiveness of a CAI lesson. For example, we don't know if analogical graphics are equally important to representational graphics or if one or the other type should be given more weight. Since no data is available regarding relative contribution of these factors to lesson effectiveness, all positive characteristic were weighted equally in determining the score. Similarly, since no data is available about the relative detriment of the negative characteristics, they were weighted equally in detracting from the total score. A "perfect" score using this Checklist would be 14. Three categories were arbitrarily designated as follows: Below 4, Poor Use of Graphics; 5-9, Good Use of Graphics; and 10-14, Excellent Use of Graphics.

The two lessons used in the comparison include Green Globs, an algebra plotting game, and Dragon Mix, a math facts game. The first lesson uses relevant graphics while the latter uses irrelevant graphics that presumably make the lesson fun for the learner. The application of the Checklist to these two lessons is given on the following page ("G" stands for Green

Globs and "D" for Dragon Mix). The Checklist yielded a score of 11 for Green Globs, indicating excellent use of graphics, compared to a score of 3 for Dragon Mix, indicating poor use of graphics. It should be noted that each of the lessons may have numerous other favorable or negative characteristics that affect their usefulness in education. However, based on the application of this checklist, the two lessons differ considerably on the basis of their effective use of instructional graphics.

There are many important elements of lesson evaluation that should be considered when selecting CAI lessons for classroom use. This paper discussed the contribution of instructional graphics to effective CAI and presented a checklist that might help the educator determine if a lesson is making good use of graphics. However, the Checklist can only guide, not decide. It is left to the educator to determine if a particular CAI lesson is appropriate and valuable for his or her classroom.

Instructional Graphics Checklist

Lesson Title ______________________________

Publisher/Year ______________________________

Subject Area/Level ______________________________

Please check each characteristic below that applies to the lesson.

Part One. Use of Graphics

_____ 1. No graphics

G D 2. Graphics shown at least 1/4 of the time

G D 3. Graphics shown at least 1/4 to 1/2 of the time

G D 4. Graphics shown more than half of the time

Part Two. Relevance of Graphics

D 5. Graphics used to decorate

G D 6. Graphics used to motivate or interest

G 7. Graphics used to direct attention to the content

G 8. Graphics used to present the content

G D 9. Graphics used to reward correct answers

D 10. Graphics used to reward wrong answers

Part Three. Types of Graphics

_____ 11. Representational graphics used to present content

_____ 12. Representational graphics used to give feedback

G 13. Analogical graphics used to present content

G 14. Analogical graphics used to give feedback

G 15. Abstract graphics used to present content

G 16. Abstract graphics used to give feedback

Scoring: Deduct 1 point each if you checked items 1, 5, or 10. Add 1 point for each of the other checked items.

Below 4: Poor 5-9: Good 10-14: Excellent

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The Effect of System-assigned Exemplar-comparison Strategies on Acquisition of Coordinate Concepts

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ABSTRACT

The Effect of System-assigned Exemplar-comparison Strategies on Acquisition of Coordinate Concepts*

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This study contrasted the effect of system-assigned strategies for learning concepts with strategies selected by students. Subject-matter content was based on a set of imaginary particle systems similar to atoms or molecules. The classification system consisted of 10 major categories and encompassed approximately 200,000 unique instances.

Treatments were implemented by a computer program that allowed students to explore the organization of the classification system by selecting and viewing paired examples of defined concepts. During this time period, students received the strategy recommendations which represent the treatment conditions.

In the system-assigned strategy treatment, students were provided with strategies for selecting matched examples and non-examples of concepts, for remembering concept attributes, and for reviewing concept definitions. In the student-assigned strategy treatment, students received non-directive placebo instructions. All strategy instructions were free of references to the subject-matter content.

Procedures. Students were screened from the student body of a continuation high school, using scores on the Wide-Range Achievement Test (WRAT). Those with a grade-level equivalent of at least 5.3 for math achievement and at least 6.0 for reading were asked if they wished to participate in the experiment. Volunteers were randomly assigned to treatment groups.

Each participant completed the conditions subtest of the Culture-Free Intelligence Test. Scores from this test were used for covariate control of prior aptitude for concept learning. Verbal instructions (based on written protocols) were used to orient students to the computer system and to introduce prerequisite content relating to the terminology of the imaginary particle systems. Students were also shown sample items from the posttest.

Students in each treatment group then used the computer system to explore the Xenograde concepts. System-assigned learning strategies and placebo strategies were provided to the respective treatment groups at at measured intervals during this period.

A thirty-item classification test administered immediately following the exploratory session served as a measure of concept acquisition.

Findings. Scores on the classification test were subjected to an analysis of covariance using scores on the Culture-Free Intelligence Test as a control for prior conceptual ability. Results indicate a borderline treatment effect ($F = 3.55$, $p = .07$) favoring the system-assigned strategies.

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The Effect of System-assigned Learning Strategies on Acquisition of Coordinate Concepts

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Effective instructional presentations must, by definition, induce mental processes that result in desired performance. Conventional approaches to instructional design usually attempt to induce the necessary mental processing through cues and other stimuli that are built into the fabric of content presentations. The content is interlaced with elements that are intended to get the learner to think about the material in helpful ways. Common examples of this approach include repeating or paraphrasing key points, asking questions, supplying illustrative diagrams or pictures and providing examples or analogies.

Independent learners--those who are free of the need for instruction--must be able to induce the required internal processing on their own. Presumably, such learners can select and apply appropriate learning strategies without help. These learning strategies are often analogous to the explicit representations of external instruction: paraphrasing or repeating to oneself, asking and answering self-generated questions, forming images, generating analogies and examples, and so on. An expert learner knows which of these internal processes will be effective methods for mastering the required skills and knowledge.

Degree of Instructional Support. But what kind of support is required by learners who fall short of such expertise? Suppose, for example, that a learner already knows something about how to paraphrase or generate an image, but is unclear about which technique would be effective for a given learning task. It is probably unnecessary (and perhaps even counter-productive) to supply learners with ready-made paraphrasings or images when they are already capable of generating these representations internally. A more appropriate method may be to assist the learner in selecting the best method for a particular learning task. On the other hand, a learner who does not possess strategies appropriate to a learning task is unlikely to profit from directions to use such unmastered skills.

Rigney's Embedded and Detached Strategies. Rigney (1978) has described a convenient framework for describing instructional treatments. He draws a distinction between embedded and detached processing strategies. Embedded processing strategies are reflected in the actual structure of an instructional presentation, in that they encourage or require the learner to process information in certain ways in order to work through the material. A student might, for example, be asked to write the answer to a specific question, to circle part of a diagram or to write a short paragraph applying new knowledge to a familiar personal problem. Detached processing strategies, on the other hand, are independent of the information to be processed. They represent decisions by the student on how to process given information. Detached strategies are based on the assumption that the student has some latitude in selecting task-relevant processing skills from a set of previously acquired skills. Thus, in reading a text book, a student might employ a number of learning strategies by, for example, paraphrasing a passage in his or her own words, by engaging in mental imagery, or by relating the new information to a previously encountered instance.

Embedded strategies minimize the demands on the student's internal processing ability by providing the processing in external form as part of the instructional presentation, while detached strategies presume previous acquisition of certain essential processing skills. Many instructional systems combine the two approaches--relying on the student's ability to self-select previously acquired processing skills for some phases of the instruction and providing (or requiring) specific processing strategies in other phases.

Rigney draws an additional distinction--crucial to this discussion--between _system-assigned_ detached strategies and _student-assigned_ detached strategies. System-assigned strategies involve recommendations to the student (by the instructional system) on when to apply one or more previously acquired learning skills. _Student-assigned_ strategies are selected by the student without guidance from the instructional system.

Learning Strategies

A learning strategy can be thought of as a cognitive process that is specifically directed toward the acquisition of new information or skills. Learning strategies may be distinguished from instructional strategies in that they represent processes that are lodged _in the learner_, rather than those which are based in the instructional presentations.

Callahan and Merrill (1980) have listed some of the learning strategies for which there is empirical support. These include repetition, paraphrasing, creating memorable images, generating or recalling examples, asking self-generated questions, constructing analogies, and so on. It should be noted here that Rigney's (1978) embedded treatments cannot in themselves be considered learning strategies because the desired processing is done for the student by the instructional presentation. Each of the learning strategies cited by Callahan and Merrill can, however, be represented as an analogous instructional strategy by making the process explicit--by repeating material for the student, for example--or by providing the paraphrasing, images, mnemonics, examples, questions, or analogies in external form. The analogous nature of these internal and external representations of processing should not necessarily imply that they rely on equivalent cognitive processes. As Neisser (1976) points out in the case of imagery, for example, construction of images from memory uses processes which may be quite different from perception of images based on immediate sensory data.

Based on the work of Rigney (1979), Bovy (1981) and Salomon (1979), Allen and Merrill (1984) have developed a model for predicting how students of varying aptitude will respond to treatments that include (or omit) recommendations on learning strategies. Listed in the order below, the following treatments reflect an increasing reliance on the student's internal resources for processing information:

1. Treatments that provide the learner with explicit (external) representations (paraphrasings, questions,

examples, analogies etc.) thereby minimizing the need for the student to generate his own representations.

2. Treatments that guide the learner in selecting and applying previously acquired learning strategies.

3. Treatments that leave the student free to select and apply previously acquired learning strategies without external suggestions or interference.

The model predicts that students with low aptitude for a learning task will profit most from the first type of treatment, that students of moderate aptitude will profit most from the second type, and that students of high aptitude will profit most from the third type of treatment.

System Assignment of Learning Strategies

The unanswered question is whether an instructional system can assume the role of guiding the student to select (from previously acquired learning strategies) the most effective strategy for any given part of the learning task. If the concept of system-assignment is to have any meaning, such guidance must be provided while the student is actually engaged in the learning task; otherwise, the student is using a student-assigned strategy.

Allen and Merrill (1984) suggest two reasons for the predicted effectiveness of system-assigned learning strategies: (1) an increase in working memory available for the learning task and (2) an increase in the relevance of learner's information-processing strategies to the performance measure.

Furthermore, Allen and Merrill (1984) suggest that effective system-assigned learning strategies must meet two criteria. First, the strategies should not interfere with the existing learning strategies of a student who already has a high aptitude for the learning task at hand. Recommending strategies to such a student entails the risk that the new strategies will compete with methods which already work. As Appalacian folk wisdom puts it, "If it ain't broke, don't fix it."

Second, there should be evidence to suggest that the target population has acquired previously a set of learning strategies (or related skills) that are appropriate to the learning task. System-assigned strategies may then serve to guide the student in selecting the most appropriate skill for a given part of the learning task. Since system assignment is defined as direction in the use of previously acquired processing skills, students who lack the prerequisite skills cannot be expected to profit from treatments based on system-assignment.

Studies of learning strategies have typically veered away from investigation of system-assigned treatments. (See for example those in O'Neal, 1978.) Instead, researchers have focused on providing students with a generalized set of learning strategies and study skills; or they have emphasized validation of a specific strategy for a limited task environment. Training in learning strategies usually attempts to cultivate a set of general strategies. During the pretraining phase, the student is taught to use several types of learning strategies. Learners may be taught how to select and apply these strategies, or it may be assumed that they can self-select and apply the appropriate strategies; but in either case, the selection process is managed internally by the student during the actual learning task. In short, these studies are based on cultivation of student-assigned learning strategies rather than validation of system assignment.

Scope of Study

This study attempts to demonstrate the feasibility of guiding moderate aptitude students to select appropriate learning strategies while they are learning an imaginary classification system.

System-assigned Exemplar-comparison strategies

Ali (1981) has reviewed the use of positive and negative examples in concept teaching. Example/non-example pairs focus attention on the critical attributes that define a concept class. When a system of related concepts is being learned, the exemplars of one concept can be compared with the exemplars of other concepts. In effect, the positive examples of one concept serve as negative examples of other concept classes.

Tennyson and Park (1980) note that the explicit comparison of exemplars is frequently recommended as an instructional strategy. In Rigney's terms, such explicit comparisons represent embedded strategies since the comparisons are provided to the student by the instructional system. These embedded exemplification strategies can, however, be transformed into equivalent system-assigned learning strategies by providing the student with recommendations on how to select or create exemplars. Such strategies would guide the student in selecting exemplars (from the student's own memory or from some external pool of instances) so as to contrast the critical attributes that determine membership in various classes.

Student-assigned strategies are those in which students use their own preferred method for selecting and comparing exemplars.

A study by Callahan and Merrill (1979) provides empirical evidence to support the feasibility of using system-assigned exemplification strategies in concept teaching. This study involved an impoverished learning task in which students were deprived of an adequate number of system-supplied (embedded) examples of a set of defined concepts. Under these circumstances, it was found that when students were directed to recall previously encountered examples of the concepts from memory, they scored higher on a classification test than did students in a control group which received no directions to recall examples from memory.

In Rigney's terms, this study compared the relative effectiveness of a system-assigned detached strategy with a student-assigned detached strategy. The embedded strategy was not included as a treatment, but could have been represented by adding an additional experiment group that would have been shown a carefully chosen set of examples illustrating each concept.

The learning strategies tested in this current study extend the work of Callahan and Merrill in two ways. The Callahan-Merrill treatment guided students to select instances that (1) were stored in the student's own memory (based on previous experience) and (2) served as positive examples of the defined concepts. The treatment described in this current study guided students to select instances which (1) were stored in a computerized data base and (2) served as negative and positive examples of the defined concepts. The strategy treatment used in the study reported here is, therefore, a better test of the feasibility of representing the example/non-example prescription as an equivalent system-assigned learning strategy.

Research Question

Can system-assigned strategies enhance concept acquisition when compared to student-assigned strategies? This study's hypothesis predicts that when students of moderate academic achievement receive system-assigned learning strategies, they will evidence higher scores on a coordinate concept classification test than similar students who rely on self-selected learning strategies. Rationale: Students of moderate academic aptitude possess previously acquired learning strategies which are relevant to concept acquisition but are independent of conceptual ability. These moderate-aptitude students will thus evidence higher scores when they receive system guidance than when they select learning strategies on their own.

Terminology

For the convenience of the reader, preceding discussion will be summarized as a set of construct definitions. These in turn serve as the basis of experimental variables.

Conceptual ability: the ability to recognize and remember new concepts. Obviously this is a very general construct. It was measured in this study by administering the conditions subtest of the Culture Fair Intelligence Test (Institute for Personality and Ability Testing, 1973).

Coordinate concept classification test: a problem in which the student must classify instances according to a system of defined concepts or categories. By definition, coordinate concepts share a single superordinate class. (Merrill and Tennyson, 1978, p. 144.) The task required of the student in coordinate concept classification problems is to correctly identify any instance with the name of the most-narrowly defined concept which it represents.

Student-assigned strategy: a learning strategy utilized by the student without system guidance.

System-assigned strategy. As used in this study, this term refers to strategies that are delivered over a separate, independently variable information channel--strategies that exclude specific references to subject-matter content. Three system-assigned strategies were used in this study:

1. a strategy for selecting and comparing exemplars from various classes;
2. a strategy for remembering the critical attributes of each concept;
3. a strategy for reviewing concept definitions.

Subject-matter Content

The classification scheme used in this study is loosely based on the imaginary science of Xenograde Systems (Merrill, 1965). As implemented in this current extension of the original Xenograde "curriculum"' the scheme groups imaginary particle systems into ten classes on the basis of the type, number and behavior of various sub-particles. In order to control for rote-memory effects, the names of the classes are based on the first ten letters of the alphabet (Alphonic, Betonic, Catatonic, etc.)

Computer Displays

Many of the constructs in this study were operationalized using specially designed computer displays designed by the investigator and developed by his associates (Eucker, Cochran, Allen & Merrill, 1982). These programs are intended as a general purpose research tool for investigating instructional design variables related to concept learning. The major features of the system are outlined below. Complete descriptions can be found in Eucker et al.

The programs present three types of displays: (1) definition displays, (2) instance selection and presentation displays, and (3) item displays for a computer-administered classification test.

Definition displays. These displays present a brief definition of each of the ten Xenograde Classes. Class definitions are based on characteristics such as the number of subparticles contained within a system's nucleus, the behavior of subparticles, the number of satellites, and the direction of satellite travel. Other attributes such as nucleus shape are irrelevant to the defined classifications and are varied automatically by the computer program according to a randomizing algorithm. Each display summarizes class attributes--including some that are irrelevant to identification of the specific class. Each display includes an example.

Classification test displays. These displays constitute the coordinate-concept classification test. Each display requires the student to identify an example of one of the various Xenograde classes by selecting the appropriate name from a provided list. Scores on this test served as the dependent variable in the experiment.

Instance selection and presentation displays. Taken together, the instance selection and presentation displays constitute a system for training students to classify specific instances of the Xenograde concepts. These displays allow for a controlled exploration of the classification system. The student selects the attributes she or he wishes to have included in a particular instance. She or he is free to create examples from any of the ten Xenograde classes. Once the attributes have been specified, the student is shown a diagram of the instance and a summary of its attributes. The system allows side-by-side comparison of two different instances. at one time. The first instance selected is labeled "example" by the system; the second instance is labeled "comparison". The student can leave the example in place and select a string of successive comparisons, or can elect to start a new "example" at any time.

Treatments

As previously noted, three strategies were provided in the system-assigned strategy treatment. These orally-administered instructions (summarized below) were based on written protocols.

Strategy for selecting and comparing exemplars. "Create an example of any class you want to learn more about. Then, follow this rule: Always choose two comparisons for each example. First, choose a comparison which is as different as possible from the example, but still from the same class. This will help you to learn the limits of the class. Then, choose a comparison which is as similar as possible to the example but from a different class. This will help you to see the difference between classes." These instructions were repeated in paraphrase, form and a card with a brief summary was placed in front of each student for the remainder of the training period.

Strategy for remembering concept attributes: "Imagine that each one of your fingers is one of of the classes . . . put the classes in some kind of order (10 second pause) . . . imagine that you can attach the special traits of each class to your fingers. This will help you keep the classes organized. . . ."

Strategy for reviewing concept definitions: ". . . try to create an example from each one of the 10 classes."

Student-assigned Strategies Treatment

In Rigney's (1978) usage, the term student-assigned refers to strategies selected and applied according to the student's own predilections. However, in order to control for factors in the system-assigned strategy treatment that might involve motivation or reduction in time-on-task, placebo "strategies" were provided to subjects receiving the student-assigned strategy treatment. These placebos were similar to the strategies described above, except that they were designed to be as non-directive as possible. The placebo method for selection of examples and comparisons was merely ". . . try to identify the special traits which tell each class from all the rest of the classes." The placebo method for remembering attributes was also non-directive: ". . . try to remember the special traits you've identified." The placebo strategy for reviewing concept definitions was ". . . take the remaining time to review what you've learned."

Measures

Construction of the computer-administered classification test was based on a random sample of the content domain. The sampling procedure employed a computer program that randomly selected attribute conditions for each item. A 30-item test constructed in this manner was piloted on a population of college undergraduates (n = 25). Using Cronbach's alpha coefficient (Merhans and Lehmann, 1975, p. 99), it was found that _ = 0.97. This indicates that item consistency was extremely high, in spite of the homogeneity of the subjects and the small sample size.

A special scoring key was developed in order to increase the ability of the test to measure partial acquisition of concepts. The key compares given responses with correct responses. Points are assigned for each item-response on the basis of the number of critical attributes shared by the given response and the correct response. Using data for the undergraduate subjects, scores adjusted in this way were found to be highly correlated with raw scores, $r = .96$, $p < .001$.

Measurement of conceptual ability. Aptitude for concept learning was measured using the "conditions" subtest of the Culture Fair Intelligence Test (Institute for Personality and Ability Testing, 1973, Form A, Test 4). The total Culture Fair Test correlates moderately well with other measures of intelligence, average $\underline{r} = .70$ (IPAT, p. 11). The test's technical manual cites several studies purporting to show that scores are unaffected by cross-cultural differences. Internal consistency of Form A items was listed as .76. As measured in the undergraduate sample, Cronbach's alpha for the conditions subtest was .65. Validity of the subtest was estimated by correlating subtest scores with performance on the coordinate-concept classification test using the same sample of students, $\underline{r} = .52$.

Procedures

A modified Posttest-only Control Group Design (Campbell & Stanley, 1963, p. 25) was used to test the hypothesis.

The Xenograde classification test served as the posttest. The conditions subtest from the Culture Fair Intelligence Test was used in a covariate adjustment of classification test (posttest) scores.

Subject Selection

Subjects were selected from the student body of a continuation high school in Southern California (N = 329). (This is an atypical high school population. According to school administrators, students had diverse reasons--both academic and non-academic--for interrupting normal high school studies.) Grade level equivalence scores on the Wide Range Achievement Test (Guidance Associates, 1976) were used as the criteria for selection. Means (and standard deviations) of the total student body for reading and mathematics were 8.2 (1.96) and 6.1 (1.55) respectively. The selection criteria established by the investigator required that a student have a minimum reading score of 6.0 and a minimum math score of 5.3. This resulted in a pool of approximately 100 students. The number of students actually participating in the experiment was 39. Means (and standard deviations) for these students were 9.3 (1.39) for reading, and 6.9 (1.19) for math. Distributions for both scores were approximately normal.

Assignment to Treatment Groups

A computer program with a random number generator was used to randomize scheduling of treatments during available school periods. As students were located and recruited, they were assigned to a specific period on a space-available basis.

Apparatus

The experiment was conducted on the high school campus in an unused classroom. Three Apple II computers were placed in study carrels. Charts summarizing Xenograde terminology and a list of definitions of the Xenograde classes were posted on the walls of each carrel. Verbal instructions were administered to students over headphones.

Summary of Instructions to Subjects

A summary of directions to students participating in the experiments follows. Important directions were read from a set of written protocols.

Orientation. Students were told that the experiment was designed to see if it was possible to use video games to teach people, and that the video game they would play involved learning an imaginary science. Students were informed that participation in the experiment was voluntary. It was announced that the highest scoring student amongst all the participants would win a $25 cash award.

Terminology and definition charts. The investigator directed attention to the charts naming the parts of Xenograde systems and reviewed each of the terms.

Definitions of Xenograde classes. The students were guided through the definition displays. As each display was presented, the investigator read the definitions of Xenograde classes as they appeared on the screen. Students were asked to note similarities and differences between classes, but were instructed not to try to memorize the definitions. Students were also told that the definitions of Xenograde classes posted in the carrel would be removed just before the posttest.

Preview of classification test. Students were led through a portion of the computer-administered classification test. The investigator read the text of the displays, showed students how to start the test, and allowed students to see the first two items. Students were reminded that they would be able to see the list of class names throughout the test and would only be required to supply the first letter of the appropriate name for each item.

Orientation to instance selection and presentation displays. Students were oriented to the use of the instance selector displays and instance presentation displays through a set of written protocols read by the investigator.

Treatment period. Students used the instance selector and instance presentation displays for 40 minutes. The system-assigned and student-assigned (placebo) strategy treatments outlined earlier in this paper were administered to the respective treatment groups during this period. Strategies were read to students at the following time intervals (measured from the start of the period).

10 minutes: strategy for selecting and comparing exemplars
30 minutes: strategy for remembering concepts
35 minutes; strategy for reviewing concepts

Classification test. Students were provided with an answer sheet and were instructed to begin the test.

Data Analysis and Findings

A series of one-way analysis of variance procedures (ANOVAs) was used to check for possible pretreatment ability differences between the experiment groups. No significant difference was found at the .01 level for reading, math, or conceptual ability.

Comparison of Group Means for the Classification Test

Means and standard deviations on the Xenograde Classification Test for the two groups are consistent the hypothesis that system-assigned strategies can improve acquisition of coordinate concepts. Means (and standard deviations) are as follows: system-assigned strategies, 46.6 (24.0), n = 20; student-assigned strategies, 33.8 (17.3), n = 19.

An analysis of covariance procedure (ANCOVA) was used to test the hypothesis (Table 1). The difference between scores for the two groups approached significance, F (1, 34) = 3.55, p = .07. The covariate was not significant.

Exploratory Data Analysis

A stepwise regression analysis was conducted to determine the sources of error variance in the ANCOVAs. Independent variables included conceptual ability, math achievement and reading achievement. Reading and math ability accounted for nearly half of the variance in classification test scores, R = .46, F(2,32) = 12.86, p < .01. Attempts to use math and reading ability for covariate control of classification scores did not result in higher levels of significance.

Correlation of Posttest with Ability Measures Correlations of reading, math, and pretest scores with the posttest ranged from r = .03 to r = -.06 and were not significant (p < .10). For the purposes of this study, these measures may therefore be considered orthogonal variables.

Table 2 displays the correlations of each ability measure with the posttest scores for each treatment group. This data shows a moderate and significant correlation between reading and math scores and posttest scores.

Inspection of the table reveals apparent differences between the ability x posttest correlations of the two treatment groups. This possibility was tested using pairwise comparisons based on Fischer's Z transformations (Glass & Stanley, 1970, p. 311). Possible contrasts between intra-group correlations were separately tested for reading, math and posttest scores. All but one of these comparisons lacked significance at the .10 level. The exception involved correlation of math scores on the WRAT with performance on the classification test: System-assigned (r = .72). vs. student-assigned (r = .23). z = 1.89, p. = .06.

In other words, there was a high correlation between math achievement and concept acquisition among students who received the system-assigned strategies and a low correlation between math achievement and concept acquisition among students who used their own strategies. Although this is a borderline effect, it suggests that the effect of the system-assigned strategies was positively influenced by pretreatment mathematics ability.

Conclusions

The direction of differences between group means is consistent with the hypothesis that system-assigned strategies can enhance acquisition of coordinate concepts. The comparison between the two treatment groups approached significance at the .05 level. Regression analysis demonstrated that nearly half of the error variance can be attributed to differences in math and reading ability. Most of the remaining error variance was probably due to unmeasured differences in cognitive ability.

Generalizing these tentative findings is a two-sided issue. On one hand, the use of an atypical group of students from a continuation high school argues against generalizing results to the other high school populations. On the other hand, the detection of a borderline effect in a group with diverse reasons for failure in ordinary school settings should engender some confidence that the experiment could be repeated with significant results, if a normal group of high school students were used.

Math as a Task-relevant Aptitude

Differences in the math X classification test correlations for students receiving system-assigned strategies and those relying on self-selected strategies suggests that moderate levels of ability in mathematics was a requirement for successful adoption of the system-assigned strategies. This is not surprising since the the recommended strategy for selecting examples and comparisons was stated in terms that required an ability to think in logical terms about set relationships.

The positive influence of mathematics ability on posttest performance also provides indirect support for the global model proposed by Allen and Merrill (1984). The global model predicts that system-assignment will be less effective than student-assignment for students with high aptitude, and less effective than embedding for students with low aptitude. The hypothesis that system-assigned learning strategies would enhance concept acquisition was therefore dependent on the crucial stipulation that the task-relevant skills of students be moderately strong. Due to the small pool of potential subjects, the investigator was forced to violate this important stipulation. Of the participating high school students, 67 percent had math achievement scores that were below the seventh-grade level. It is likely, therefore, that system-assignment was an inappropriate method for many of the experiment subjects and that embedded strategies (such as one that explicitly compared matched example/non-example pairs) would have been a more effective treatment for these students.

Table 1

Analysis of Covariance

System-assigned vs. Student-assigned Strategies

Source	df	MS	F	p
Covariate Conceptal Ability	1	36.1	.08	.78
Between Group	1	1573.2	3.55	.07
Explained	2	804.6	1.81	.18

Table 2

Correlation of Student Ability with

Classification Performance

Group	n	Conceptual Ability	Reading Achievement	Math Achievement
System-assigned strategy	20	.12	.35	.72 **
Student-assigned strategy	19	.43	.63 *	.23

* $p < .05$
** $p < .01$

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Prose-Relevant Pictures and Older Learners' Recall of Written Prose

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Running head: PICTURES AND RECALL

Abstract

Research examining the contribution of pictures to young children's recall of prose materials suggests that pictures can be used to facilitate the recall of information presented in prose passages. Can positive effects found with young children be extended to older learners? If picture effects are present, are they durable over time? Data collected from two experiments including college students provide evidence for an affirmative answer to both questions.

Prose-Relevant Pictures and Older Learners' Recall of Written Prose

There is now substantial evidence that pictures can be used to facilitate the recall of information presented in prose materials. Levie and Lentz (1982), in a major review, concluded that "when illustrations provide text-redundant information, learning information in the text that is also shown in pictures will be facilitated" (p. 225). The reviewers reported that the average improvement was 36% for groups reading with pictures in comparison to groups reading text alone. Most studies reported in the literature investigating the contribution of pictures to prose learning have used younger learners (grades K-6) as subjects (Alesandrini, 1984; Levie & Lentz, 1982; Levin, 1981; Levin & Lesgold, 1978). In the Levie and Lentz review, 23 studies examined learning illustrated text information. Of these 23, only three included more mature learners (i.e., post-secondary school learners) as subjects. Additional studies with older learners are needed in order to determine if the results with young children can be generalized to other audiences.

This study investigated the possible contribution of prose-relevant pictures to the recall and retention of information presented in written prose materials with older learners as subjects. The first variable considered in this investigation was the extension of the positive picture effects found with young children to college-age students. The second variable considered the durability of the picture effects. Peng and Levin (1979) suggested that "in order to prove implications for classroom learning situations, it must be demonstrated that gains attributable to pictures are not short-lived" (p. 39). The durability of picture effects with second and fourth graders over a 3-day period has been demonstrated (Levin & Berry, 1980; Peng & Levin, 1979).

In this study two experiments using older students as subjects were conducted. In the first experiment, recall of information presented in written prose materials was assessed immediately following presentation of a prose-plus-picture passage (or prose-only passage) and 14 days later. The second experiment was similar to the first but the delayed test was administered 26 days following the immediate test.

Experiment 1

Method

Subjects and Design. Fifty-two graduate students from a southeastern university were randomly assigned to either a prose-plus-picture (27 subjects) or prose-only (25 subjects) group. In the prose-plus-picture condition, the students read the prose passages and viewed the accompanying pictures. In the prose-only condition the subjects read the prose passages without the pictures.

Materials. Three human interest stories were chosen from Time, a weekly news magazine. The passages were approximately one-half to three quarters of a page in length, typed and double-spaced. One article described an individual who had set up residence on a traffic island on Manhattan. Another was about skateboarding in Madison, Wisconsin, and a third described a neighborhood's solution to waiting in long lines so that their children could see Santa Claus in a department store.

For each passage, a single, 8 and 1/2 by 11-inch line drawing was produced to represent or duplicate the passage information. Levin (1981) has described the representation function of pictures as that of making the prose passage more concrete. The picture was presented on the page following the prose passage. The picture used for the traffic island passage is presented in Figure 1.

Insert Figure 1 about here

Five short-answer paraphrase questions were constructed for each passage using Anderson's (1972) recommendations. The questions tested recall of information that was presented in the passage and specifically pictured. The five test questions for each passage were reproduced on three separate pages. The title of the passage appeared at the top of the appropriate test. Prior to Experiment 1, the 15-item test was administered to a group of 16 graduate students to verify that subjects would not be able to answer correctly the questions without reading the prose passages and/or viewing the pictures. Average recall for the 16 graduate students was 3%.

Procedure. The treatments were administered in a group format. Instructions were printed on the cover sheet accompanying each of the three prose passages (and pictures if appropriate). Subjects in the prose-plus-picture group were instructed to read the passage and view the accompanying picture once. Prose-only subjects were instructed to read the passage once. Subjects read the material at their own pace. Subjects were asked to raise their hand when they had completed the task. The experimentor collected the instructional treatment and administered the appropriate 5-item test. A similar procedure was used for passages two and three. Fourteen days later the students were tested in the same manner, with the same 15-item test as used in the immediate condition (five items per passage).

Results and Discussion

After Experiment 1 was completed, a problem was identified with regard to one of the 15 test items. Based on information presented in the prose passage, more than one correct response was possible. As a result, the item was deleted from the analysis.

The first analysis compared the prose-plus-picture group with the prose-only group for the immediate and delayed testing conditions. One-tailed significance tests were used based on the direction of differences found in previous studies with young children and the limited number of studies done with adults. In the immediate testing condition, the average recall of prose-plus-picture subjects (88%) was significantly higher than that of control subjects (75%), t (50) = 4.00, $p<.001$ (one-tailed). For the 14-day delayed testing condition the average recall of prose-plus-picture subjects (87%) was also significantly higher than that of prose-only subjects (71%), t (50) = 4.96, $p<.001$ (one-tailed).

The second analysis was performed to determine if a significant amount of information was lost over the 14-day delay for both the prose-plus-picture and prose-only groups. Prose-plus-picture subjects' average recall of information in the immediate (88%) and delayed (87%) conditions was not statistically different, |t|<1. In the prose-only condition, the average recall for subjects was 75% and 71% for the immediate and delayed testing conditions, respectively. When subjected to a paired t-test this difference was significant ($t(24) = 2.12$, $p<.05$ (two-tailed)). Picture effects were observed in the immediate and 14-day delay conditions while a significant amount of information was lost over time only in the prose-only group.

Experiment 2

The second experiment was conducted to determine if the results observed in Experiment 1 would be similar if the time between administration of the treatments and the delayed test was extended. Materials, methods and procedures were similar to Experiment 1 but the time between the immediate and delayed test was extended to 26 days.

Method

Subjects and Design. A different group of forty-seven graduate students from the same southeastern university as subjects in Experiment 1 were randomly assigned to prose-plus-picture (22 subjects) and prose-only (25 subjects) groups. As in Experiment 1, students in the prose-plus-picture condition read the prose passages and viewed the accompanying pictures. In the prose-only condition, subjects read the prose passages without pictures.

Materials. The prose passages and pictures used in Experiment 1 were also used in Experiment 2 (three passages, three pictures). In addition, the same 15-item test was used. The one problematic item observed in Experiment 1 was rewritten.

Procedure. The treatments were administered in the same manner as they were for the first experiment. Testing was done immediately following completion of the treatments and 26 days following the administration of the treatments.

Results and Discussion

Significant picture effects were identified in both the immediate and delayed testing conditions. In the immediate testing condition, the average recall of prose-plus-picture subjects (89%) was significantly higher than that of prose-only subjects (79%), $t(45) = 3.60$, $p<.001$ (one-tailed). For the delayed testing condition (26-day delay) the average recall of prose-plus-picture subjects (75%) was also significantly higher than that of prose-only subjects (61%), $t(45) = 3.91$, $p<.001$ (one-tailed). Average recall was lower for both groups in the delayed testing condition. Prose-plus-picture subjects' average recall in the immediate (89%) and delayed (75%) conditions was statistically different, paired $t(21) = 9.01$, $p<.001$, two-tailed. Prose-only subjects' average recall in the immediate (79%) and delayed (61%)

conditions was also statistically different, paired $t(24) = 9.58$, $p<.001$, two-tailed. Picture effects were durable over the 26-day delay, but both groups lost a significant amount of information.

General Discussion

Results of this study support the claim that prose-relevant pictures do contribute to older learners' increased recall of prose materials. In two experiments, graduate students who read prose passages and viewed accompanying pictures remembered more of the information that was pictured and included in the prose passages than those students who read the same prose passages without the pictures. Facilitative picture effects were observed in both immediate and delayed (Experiment 1, 14-day delay; Experiment 2, 26-day delay) testing conditions. The prose-plus-picture groups retained more information over the 14-day (Experiment 1) and 26-day (Experiment 2) delays than the prose-only group. In the 14-day delay condition the prose-plus-picture group, in contrast to the prose-only group, did not lose a significant amount of information. While both the prose-plus-picture and prose-only groups' average recall was significantly lower for the 26-day delayed testing condition (Experiment 2) than in the immediate testing condition, the difference between the average recall of prose-plus-picture subjects and prose-only subjects increased.

Levin (1981) has argued that subjects' increased recall in prose-plus-picture conditions in contrast to prose-only conditions may be due to greater memory trace strength in the prose-plus-picture condition. He stated, "According to the representation function, pictures lay down a 'memory trace' that ... is stronger than that associated with a strict verbal representation of the text" (Levin, 1981, pp. 214-215).

Findings of the current study are consistent with studies reported by Levin and Berry (1980) and Peng and Levin (1979), in which the subjects were children and prose passages included human interest and novelty stories. In the current investigation average recall for prose-plus-picture subjects was 10%-16% higher than that of prose-only subjects. Levin and Berry and Peng and Levin reported similar results (13%-20%). In both the Levin and Berry and Peng and Levin studies, representational pictures were used in the picture conditions.

The magnitude of the picture effects observed in this study were lower than the average improvement (36%) reported by Levie and Lentz (1982). This lower average improvement may be due to ceiling effects present in both experiments. In Experiment 1, prose-plus-picture subjects' average recall of information in the immediate and delayed testing conditions was 88% and 87%, respectively. Similar ceiling effects were observed in Experiment 2. Alternatively, some of the pictures included in the 23 studies reviewed by Levie and Lentz may not have functioned as representational pictures using Levins' (1981) definition. Finally, as Levin and Berry (1980) have suggested, the particular type of prose passages (human interest stories) may have affected the size of the picture effects.

Can positive picture effects found with young children be extended to older learners? If found, are the positive picture effects durable over time? Results from this study provided support for an affirmative answer to both questions. Further extension of the findings to other audiences, for example, adult learners who are not involved in formal school settings, is needed. The limits of the durability of positive picture effects warrants further study. If individuals, in fact, can remember more information over extended periods of time reading prose with pictures, then these results would have practical implications for educators, instructional designers and others involved in the educational process.

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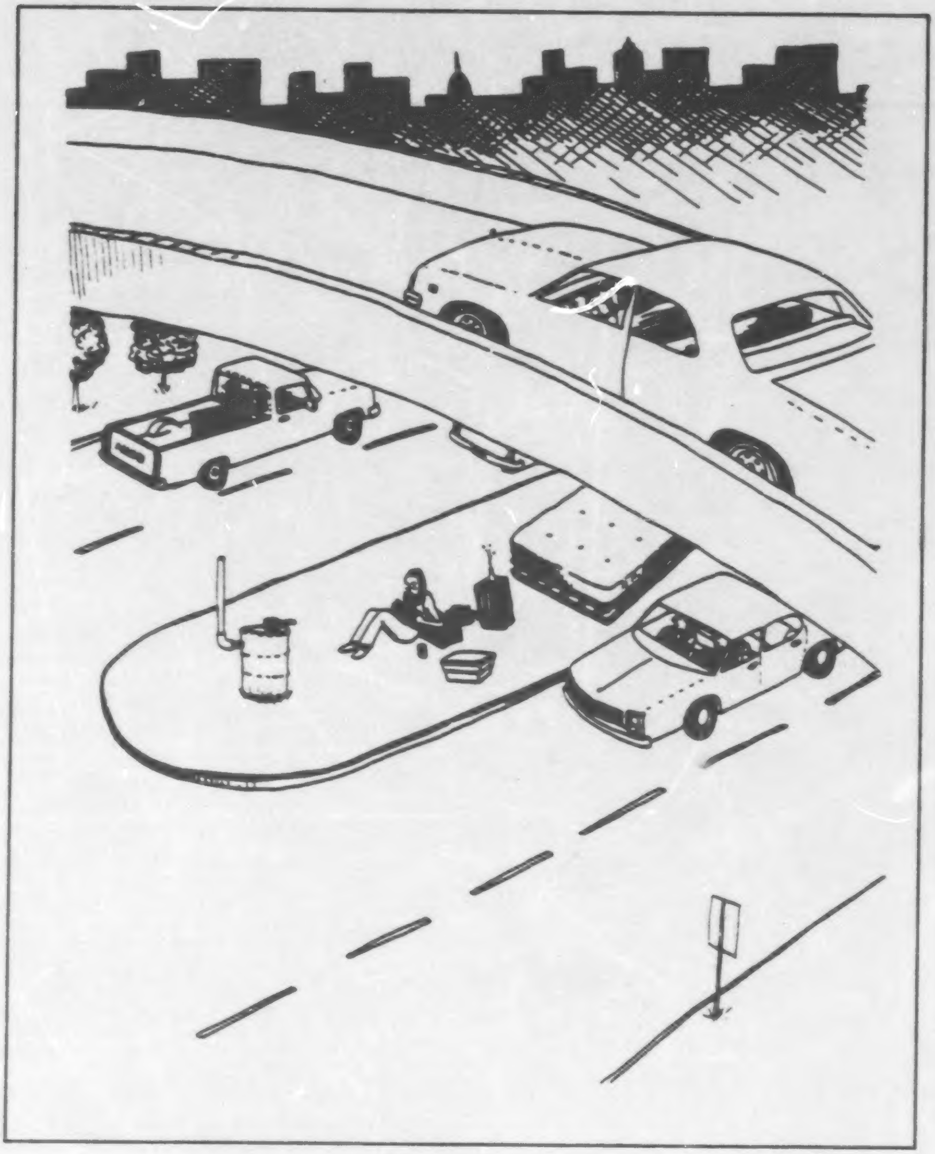
Figure 1. Picture Accompanying One of the Prose Passages in Experimental Condition.



Reader Theories, Cognitive Theories and Educational Media Research

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Reader Theories, Cognitive Theories and Educational Media Research

This paper is the introduction to an inquiry into the relationship of post structural reader theories to cognitive theories in the study of educational media. This inquiry will define some basic concepts in reader (Harari, 1979) and cognitive theories, and describe their similarities and differences. It will recommend application for media research in the separate paradigms from which these theories emerge. My presentation today represents only the first portion of this larger inquiry.

Explanations for learning when instructional media are employed in an educational setting have traditionally drawn upon a behavioral model. Current research and theory in instructional technology indicate the limitations of such a model and the difficulty, in general, of assessing the effects of a medium. Exploration of cognitive theories has recently provided researchers with a more elegant explanation of learning. In fact, the power of these theories to inform the construction of learning models, such as the propositional model, is great and far from exhausted. Cognitive theories, however, assume a psychological explanation for learning which emphasizes individual mental functions and considers the individual as a unit. While this approach is a time honored one and necessary in educational research, there is another approach to learning that is not often employed in this field. That approach is a structural one.

Disciplines, such as biology, zoology, anthropology, sociology and communication arts, to mention a few, inquire about the nature of human behavior. Investigators in these fields employ psychological and social models for explanations of behavior and a description of interaction. Psychological and social models exist side by side, albeit not always peacefully, within these disciplines. In fact, it is the debate between proponents of these diverse models which helps elaborate the description of human behavior.

An educational investigator working within the psychological model might ask the question, "How does a viewer learn from a presentation?"; while an investigator employing a social model might ask, "How do viewers derive meaning from a presentation?". Yet the latter question does not vitiate the former. They may in fact be considered complementary since educational research deals with social, psychological human beings. The former question constructs the viewer in a psychological form, while the latter constructs the viewer in a social mode. The dichtomy persists even though post structural reader theories appropriate psychoanalytic theories, such as those of Freud and Lacan (Harari, 1974) to partially construct the viewer. The difference resides in the dichitomous application of psychoanalytic theory within the two paradigms. A cognitive paradigm applies these theories to explain learning and brain functions where the brain of the viewer is considered as a unit. Structural and post structural theories, however, focus on the viewer as a member of a social group historically and at a moment in time. These theories appropriate psychoanalysis to partially explain how a viewer creates meaning.

One method of approaching the question, "How does a viewer derive meaning?" is the application of structural analysis.

Loosely conceived, structuralism is a way of thinking about the world which is predominantly concerned with perception and the description of structures. This notion of structuralism, then, would include researchers working in many disciplines under varying paradigms. Piaget, for example, working within the cognitive paradigm would be called a structuralist, since he describes and works with structure. Loosely conceived, a new form of behaviorism, sociobiology, would be considered a structural theory, because its proponents study the social interaction of animals.

More strictly conceived, however, structuralism provides a framework for organizing and orienting any study concerned with the production and perception of meaning. It focuses on those human acts or behaviors that involve cultural construction the way that speech acts involve sentences. It is this notion of structuralism which provides a rich framework within which to examine media viewers and their social knowledge.

It is important, here, to understand some basic concepts of the more narrowly defined structuralism. This theory talks about the concept and perception of meaning rather than the concept of learning. "Meaning", here, is that which one intends to convey by a human act, especially language. "Meaning" may be an act signified by language. In this theory knowledge accrues by perception of meaning, not by information processing, nor the acquisition of a skill, nor the construction of strategies of knowledge. Structurally conceived, the relationship between the observer and the observed becomes primary. Knowledge, here, resides in the relationships which people construct and then perceive.

Semiotic analysis was the first form of structuralism (before Levi Strauss) which offered a model to decode linguistic and media texts. While this analysis focused on the structure of a film or television presentation and the embedding of messages within the form of the medium, it failed to consider the interaction of the viewer with the medium. Employing the same basic structural premises, post structural investigators have suggested models of analyses which include the viewer and his/her perceptions. Such theories are currently called reader theories, theory of the subject, and deconstruction theories. The inclusion of the reader or viewer in the structuralist equation brings the model closer in form to cognitive learning theories.

What, if any, are the similarities between post structural reader theories and cognitive learning theories? Are they only dichotomous? Can they both contribute in a complementary fashion, to the elaboration of our concept of learning and media? I will attempt to partially explore that relationship here. Within the behavioral paradigm, educational researchers were interested in the learner and learning. The learner was defined as someone who responded to a stimulus and who was active. It appears that action within this paradigm simply meant outward motion, because the observation of outward motion was the only way one could evaluate learning or response to a stimulus. Outward motion could include a pencil response to a verbal question. The idea of action, then was simply that it was reaction, not action motivated by intention nor coming from within. Within the behavioral paradigm the learner was said to learn by engaging in repeated trials of the behavior to be learned, by the application of reinforcement to the practice of the behavior, by the presence of cues and prompts and the fading of such. It is not the purpose of this paper to mount an argument against the behavioral paradigm and the definition of learning or the learner within that paradigm, but simply to evoke the old definitions for purposes of comparison with the new definitions in the cognitive paradigm. As we are now aware, a paradigm shift is occuring within the field of educational technology (Clark and Salomon, 1985) and has occurred within the area of educational research in general. (Wittrock, 1978, Weinstein and Underwood, 1983, and Diekhoff and Diekhoff, 1982). Those shifts have also affected instructional design and development (Foshay, 1983, Terrell, 1983) which area, to date, has been articulated with exquisite detail along behavioral lines. Perhaps this articulation is the reason why many academics, unfortunately, do not take instructional development seriously.)

I would like to consider learning and the learner in the cognitive paradigm, so that I may compare these concepts as they appear in the post structural paradigm. Learning is a richer concept within the cognitive paradigm, than it is in the behaviorla paradigm. Learners, Wittrock (1978) indicates are actively engaged in constructing or generating meaning from material. The explanation builds on the behavioral definition of learning. When a learner interprets any stimulus, he/she constructs meaning based upon prior learning. Comprehension is a key concept here and proceeds with the learner attending to incoming stimuli, accessing existing knowledge to relate to it, abstracting new knowledge structures and finally encoding those into memory. (Rumelhart and Norman, 1978) This learning process results, in some cognitive theories, to ammended knowledge structures which then may be accessed to interpret new information. This is a truly active event for the learner, not just a response to a stimulus. Meaning or understanding is generated by the learner not controlled by the technology or its designer. (It is a while since we have heard the words meaning or understanding, since they had no place in the behavioral paradigm. Yet they are old concepts within gestalt learning theory and meaning is a central concept, as I have noted, in the structuralist paradigm. Meaning in the cognitive and structuralist paradigms differs).

The shift to a focus on the learner and knowledge structures within the cognitive paradigm has vast implications for instructional designers working within that paradigm. Designers will need to become less hardware oriented and less systems dependent or dependent on new systems which they should construct. They need to be "more concerned with how the viewer learns from media. They need to be concerned with facilitating, not controlling learning". (Jonassen, 1984) They will need to focus on learning to learn and it is this which should inform any new designs systems which emerge in the cognitive paradigm. As Winn (1981) so notes, they will need to focus on learning strategies, and expand mental effort to increase the learner's repertoire of mental skills.

It might be helpful to compare the view of the learner in the cognitive paradigm with that of the learner/viewer in the structural paradigm. Within cognitive theories the learner is said to apply learning strategies to the material to be learned. He/she may use procedures to acquire, retain and retrieve different kinds of knowledge and performance (Rigney, 1978). The procedures or competencies might include information processing strategies, such as organizational skills; active study strategies, such as note taking or outlining; support strategies, such as time structuring or relaxation techniques; and metacognitive strategies in which learners become aware of and monitor their learning. (Weinstein and Underwood, 1983).

Post Structural Reader Theories

Learning is never spoken of as such within the structural paradigm and learners are never mentioned. Readers are mentioned, as are viewers, but the concern for the viewers' creation of meaning is common to the two paradigms. As mentioned above, structuralism is concerned with the production and the perception of meaning and meaning is that which one intends to convey by a human act, especially language. Immediately, one can see that this paradigm is concerned with media communication as a social act.

Social issues were crucial research issues within the area of educational technology before World War II. The area, in fact, was called the audiovisual area and the organizational name preceeding AECT was DAVI, the Division of Audio Visual Instruction.

Before 1940 artists, Hollywood filmakers, librarians, educators, educational administrators, mass communication workers and government representatives constituted the membership of DAVI. Varied professionals kept the interests in this field broad, but the broad perspective was lost after WWII in the age of specialization. Within the new instructional technology, participants gained rigor in research and design methods, but lost an interest in social issues. Areas of film and TV studies and mass communication in general did not lose this interest and as we developed rigorous experimental methods for instructional media inquiry, they developed rigor in research of social issues in mass media. I have always thought it strange that instructional technology should consider social issues the domain of mass communications. It was as if educational media were associated only with learning and brain functions. Yet, one may ask if the presentation of three cultures in a new national social studies videotape series called, "Across Cultures," is such, that student viewers may appreciate and vaule each culture. Our normal questions would have centered around the issue of how well can a student learn from this series? The series, however, prejudices the learner in favor of the wealthier culture and tends to denigrate the poverty stricken culture. Evaluators measuring student recall of factual information would not uncover this fact. Yet, we bypass the responsibility of investigating social issues in educational technology, because it does not fall within our research paradigm. And why should it be left to the sociologists to study the social interaction of children in a classroom in which a videodisc system is present? Are we not the ones who will design much of the educational videodisc programs? It is these types of questions within our field that call for a paradigm based on social communication such as the structural or post structural paradigm. This paradigm would accomodate such questions such as, "How does a teacher decode computer advertisements?" Designers and producers of software should be interested in that issue. Questions of how educational messages are coded and decoded in any medium are of interest to us all.

Structural analysis in film and television studies and mass media have offered us guidelines for the consideration of social issues in educational technology. Within this analysis the relationship between the observer and the observed becomes primary and meaning resides in the relationships which people construct and then perceive.

Semiotocs, which is a system for the study of sign and symbols within any communication system, offers us a theory within the structural paradigm. Methods of observing and decoding may be drawn from the social sciences, if one is to apply semiotic theory. Helpful semiotic studies and observational methods are summarized in another paper (Becker, 1983) and are mentioned here as a base for research which followed. It is that research, post structural study, that is of interest here.

As mentioned above,post structural researchers building on structural concepts, have included the viewer, not just the text or the medium, in their structural equation. Some of these new theories may be called reader theories and are used, not just in literature, but in film and television studies. The difference with these reader theories and what preceeded them is the emphasis on the viewer and his/her construction of meaning. Heretofore, meaning within semiotic study was encoded in the text. Now, meaning does not become meaning until the reader or viewer decodes what has been encoded in the text or film or TV presentation. This is the development that brings post structuralism closer to cognitive theory. Post structurally, meaning can only be understood as what the individual intends. It is, therefore, the individual's intentions which produces the specific relations of differences or similarities, within the structural unit.

How would the learner be perceived in post structural studies? Essentially he/she would be understood as the subject (Coward and Ellis, 1977) of the meaning, since he/she creates meaning from the text or media presentation. How does that understanding differ from the learner in the cognitive paradigm? The difference resides in the fact that post structural study deals, as mentioned above, with social knowledge, so the learner or viewer is constructed as a social person belonging to a group, not as an individual person whose brain is a unit. Investigation of how social groups such as, first graders, female math students or first time compuer users construct knowledge would be conducted. Analysis of how the text or media presentation is encoded is ignored, but becomes secondary to the questions of decoding by a specific social group. (Culler, 1982) In fact, messages may be so encoded in the presentation that space for certain viewers, such as female math students or first time computer users, is excluded. Yet, these exclusions may not be obvious to the designer. It is the viewer who has to tell us. Psychoanalytic theory (Lacan, 1977) can be used to help us understand the viewer and his/her social knowledge.

This portion of the inquiry into the relationship between cognitive theories and reader theories has attempted to describe notions of meaning and the learner within the two paradigms. It has described some of the assumptions underlying both these theories, and suggested implications for handling social and psychological research issues in educational technology. The next section will describe those successful reader theory studies which could be used as guidelines for educational technology research.

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The Psychological Construct of Encoding Specificity and Its Relationship to Designing Instruction and Tests

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Research Problem

Prior to explaining the research problem addressed by this study, two questions should be considered. The first question that should be considered is, "What is encoding specificity anyway?". The second correlative question is, "Why is encoding specificity of significance to the field of educational technology and its related interest areas?"

Considering the first question, encoding specificity is a psychological construct that involves the interaction between the encoding phase of memory, or the learning context, and the stored memory trace, and retrieval cues present at the time of testing for learned information. In other words, retrieval of a memory trace at the time of testing, can be a direct function of the match between cues given during learning, and cues provided during testing. The more isomorphic learning context cues are with testing context cues, the more likely the probability of successful memory performance. Of course, given a miss-match between these elements, the inverse will occur. The major issue here is that memory of learned information is not simply a function of cognitive or mental factors alone, but is actually influenced by cues given at the time of learning and cues given at the time of testing. Considering the logical progression of the encoding specificity theory, it is possible then to have information learned or stored in memory, but with testing cues too abstract in relation to learning context cues, test performance becomes a function of the type of cue provided, not what was actually learned. In other words, the learner has learned the information, or mastered certain objectives, but performance fails as a function of the test not what material has been mastered by the learner.

The answer to the second question may at this time be obvious. Encoding specificity is an important construct for educational technology, since our primary objective is the design of effective learning environments, and the ability to evaluate the relative success of learning specific objectives. The encoding specificity construct adds an additional consideration to the design of learning environments that is the concern for the match between learning context cues, the stored memory trace, and testing context cues. Care should be taken, however, to not consider the encoding specificity construct as simplistic, or common sense. The counter argument to this notion is the large number of studies done investigating encoding specificity and its complex effects upon memory (Tulving, 1979; Thomson and Tulving, 1970). An additional argument favoring encoding specificity research as an important research topic for educational technology, is the vast number of classroom tests that present mostly verbal information while related instruction may be visually oriented.

Now that the encoding specificity construct has been defined and its importance defended, why have the authors decided to further investigate encoding specificity since so much seems to be known about it already from psychological research. The primary problem in much of the psychological research on encoding specificity is the incongruence between psychological experimental designs and real learning environments typically found in schools and training situations. The traditional encoding specificity study uses a paired-associate learning paradigm, processes subjects on an individual bases, and uses very simplistic learning tasks (i.e., stimulus-response learning). For example, the study by Tulving and Osler (1968) used the following experimental design. The two encoding, or learning, conditions were: (1) target words plus cue type A, and (2) same target words plus cue type B, these form the paired-associate. The two retrieval conditions were: (1) present retrieval cue type A, get response, and (2) present retrieval cue type B, get response. The Tulving and Osler (1968) experiment resulted in the following percentages of correct recall.

Learning Context	Retrieval-Testing-Context	
	See Cue A	See Cue B
Targets 1...n+A	62%	29%
Targets 1...n+B	33%	62%

While their results clearly showed that even though both learning context groups received and learned the same target words, successful performance was a function of test cue type, not what was originally learned.

The problem with this type of experimental design, which represents the typical encoding specificity study, is that it is far removed from classroom instruction which typically is group learning, with academic content, and group testing. The primary problem addressed by the present study is the highly clinical nature of past encoding specificity research. The present study was designed to evaluate the effects of encoding specificity when learners were in a typical classroom group learning environment, receiving an audiovisual presentation on an academic subject, and in a group testing environment. However, it was important that the basic encoding specificity design of 'target to-be-learned information' and 'varying cue type' remain constant in the present study. In other words, the basic integrity of the encoding specificity design was not changed. To accomplish this the three learning conditions in the present study, presented the same to-be-learned target information, but in different learning contexts, each having different contextual cues. However, the to-be-learned target information was identical in each of the three learning conditions. Similarly, there were three testing conditions, each condition presenting a different set of cues corresponding to the learning context cues. So the basic encoding specificity design is apparent in the present study but, students received their instruction in a classroom group setting, seeing a slide-tape presentation, the instructional content information was a typical type of academic content material, and testing was done in a classroom group setting.

Experimental Design

The present study represents the third in a series of studies done by the authors on the variable of encoding specificity, and its effect upon learning-memory-testing. The first two studies yielded significant results, partially supporting the encoding specificity hypothesis and revealing the significant relationship between the learning context, stored memory information, and the testing context (Canelos, Taylor, Altschuld, 1983; Canelos, Taylor Dwyer, 1984). However, this study is an attempt to refine the pilot study (Canelos, et al., 1983) and follow-up study (Canelos, et al., 1984) by adding an instructional treatment and refining the testing, or cueing conditions. These refinements should yield results that are more generalizable to the classroom instructional situation. Additionally, these refinements should result in the cross-over statistical interactions found in psychological experiments investigating the encoding specificity variable, but within the domain of a classroom learning environment (see hypothesis of interaction, Figure 5). During the AECT-1984 RTD presentation of the follow-up study the discussant, Dr. Lamberski, recommended further experimentation with our research design on encoding specificity. Dr. Lamberski also suggested that educational technology researchers should follow through with their research by conducting a series of experiments on a given variable to refine and make more applicable their conclusions.

The original pilot study partially supported the encoding specificity hypothesis, which states that: retrieval is facilitated if external retrieval cues, given during testing, match a part of what is stored in memory, as a function of the original learning context. While some researchers may claim such a hypothesis is common sense, in the real world of classroom testing, there is often little attempt to match instructional context cues to cues given on the test. Most classroom tests are verbal, but if visuals were a significant part of the instructional/learning context (i.e., medical and engineering instruction) recall will be debilitated. In this case, the learner may have learned the correct fact or concept, but given only verbal cues on the test, cannot effectively respond. The original pilot study used the following experimental design.

		Free Recall	Visually-Cued Recall Test	Verbally-Cued Recall Test
Immediate Test	Visualized Instruction Plus Audio Program			
	Verbalized Instruction Plus Audio Program			
Seven-Day Delay Test	Visualized Instruction Plus Audio Program			
	Verbalized Instruction Plus Audio Program			

Figure 1: Original Pilot Study Design

The pilot resulted in the following disordinal interaction finding partial support for the encoding specificity hypothesis.

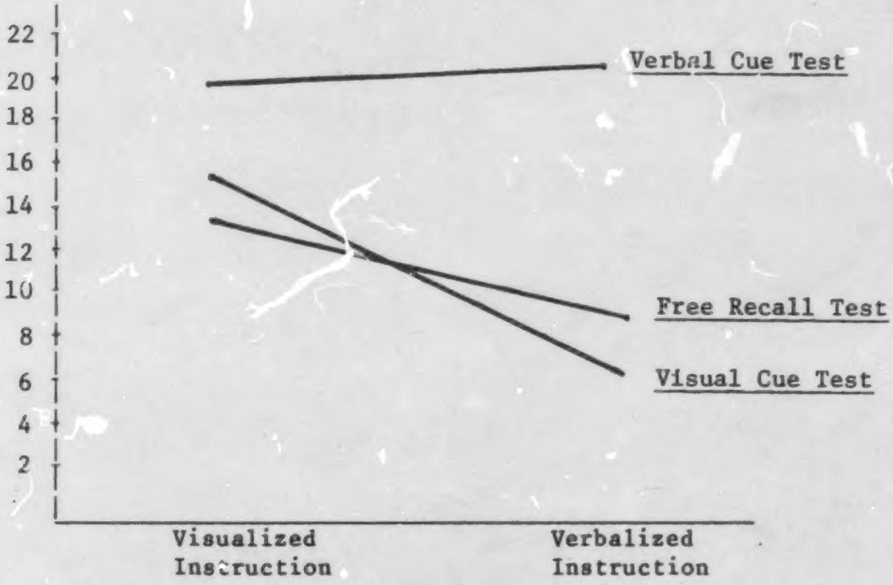

Figure 2: Original Resulting Interactions

However, further analysis revealed that the strong results on the verbal-cue test occurred because the test was operating as a recognition test, rather than a cued recall test. Recognition tasks tend to be easier than free recall and cued recall tasks.

In the second study, the verbally-cued recall test was changed to function as a cued-recall measure. To evaluate this change the second study was conducted using the following experimental design.

		Free Recall	Visually-Cued Recall Test	Verbally-Cued Recall Test
Immediate Test	Visualized Instruction Plus Audio Program			
	Verbalized Instruction Plus Audio Program			

Figure 3: Follow-Up Study Design

This design yielded the following change in the results, and again found partial support for the encoding specificity hypothesis, as indicated by disordinal interaction in Figure 4.

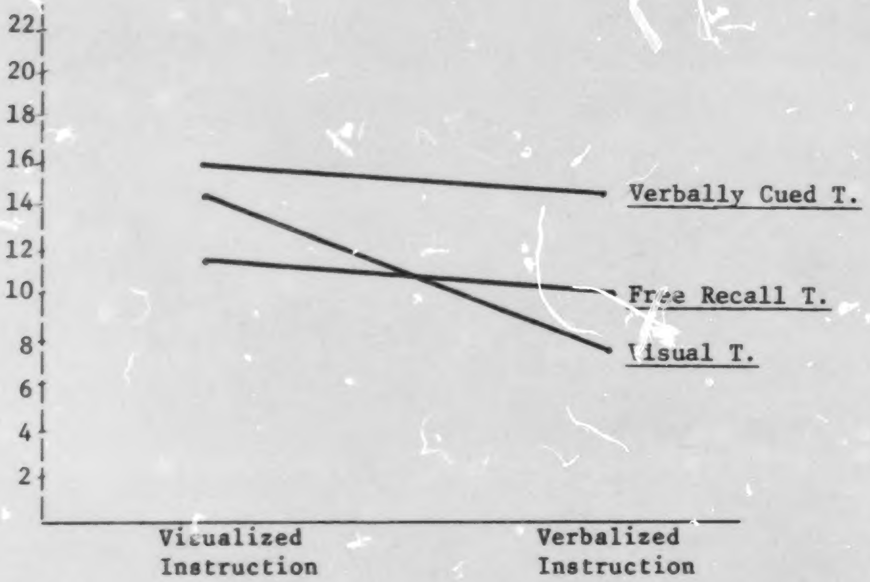

Figure 4: Follow-Up Study Interactions

As can be seen, the verbally-cued test is operating more like a cued recall test than a recognition test. However, the encoding specificity hypothesis would have predicted a cross-over interaction, finding that subjects receiving visualized instruction would do well with visual cues during recall but not verbal cues, resulting in the following hypothetical interaction.

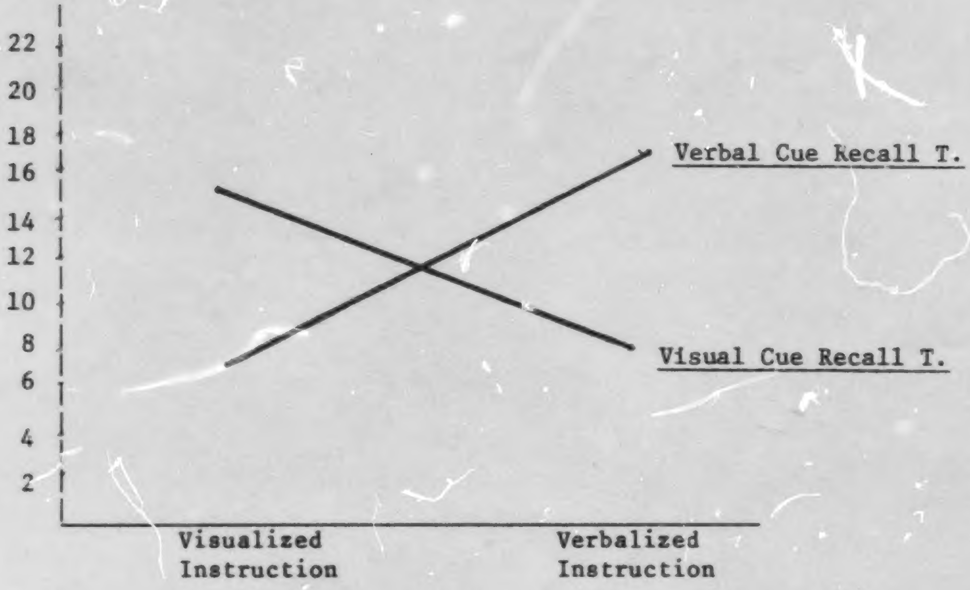

Figure 5: Hypothesized Resulting Cross-Over Interactions

This did not occur in the follow-up study because the visualized instruction group's slide-tape instructional program contained a visual slide with a word label indicating the part name. This label must have been stored in memory along with the visual context on the slide, since the visualized instruction group performed equally well with the visually cued recall and verbally cued recall tests.

The hypothesized interaction, presented in Figure 5, represents the general hypothesis for the present study, which used the experimental design in Figure 6.

		Free Recall Test	Visually-Cued Recall Test	Verbally-Cued Recall Test
Immediate Testing	Visual Only Slide Set Plus Audio Program			
	Visual with Label Slides Plus Audio Program			
	Verbal Label Slides Plus Audio Program			
Seven Day Delayed Testing	Visual Only Slide Set Plus Audio Program			
	Visual with Label Slides Plus Audio Program			
	Verbal Label Slides Plus Audio Program			

Figure 6: Present Study's Experimental Design

The instructional programs were an adaptation of the Dwyer (1967) human heart instructional and testing materials. The instructional materials were adapted to fit the design of an encoding specificity study however, this adaptation did not change the validity of the Dwyer materials as a logical audiovisual instructional program about the parts and operation of the human heart. The Dwyer instructional materials about the human heart consist of an instructional presentation designed to teach the names of the parts of the heart, heart part locations, and the part functions during the blood flow process taking place as the heart operates. The Dwyer instructional program on the human heart has been adapted to a variety of experimental studies, ranging from programmed learning, print materials, and computer based learning. The present study uses the instructional media of a slide-tape audiovisual classroom presentation of the basic Dwyer heart instructional program.

The experimental design is a 2x3x3 Lindquist type-II design. There are two between subjects variables and one within subjects variable. The within subjects variable was time of testing. The two levels of the within subjects variable are immediate testing and seven day delayed testing.

The first between subjects variable was type of instructional program. Each instructional program was a slide tape program about the parts and operation of the heart. Each of the three instructional programs provided the same to-be-learned target information, which was the names of the parts of the heart, and the heart phase names. This information was provided in the audio portion of the slide tape program, which was from the original Dwyer heart audio script. All three instructional programs used the same audio program tape, having the same heart part/phase description, and same pacing by a synchronized pulse. The difference in the three instructional programs was the type of cue provided by the slide portion of the audiovisual program.

The first level of the instructional program variable was the visual only slide set plus the audio program. The audio program was 22 minutes in length and described the parts of the heart, the part names and locations in detail, and the heart's operation. The first level of the instructional program variable slide set contained 37 color visual illustrations of the heart. Each of the slides contained an arrow, or arrows, pointing to the part being described by the audio program, or the phase or operation being described. The visual only slide set provided only visual cues on each slide.

The second level of the instructional program variable was the visual with verbal label slide set. This instructional program used the same audio program tape but the cues given were quite different than level one. The same 37 color visual illustration slides were used, as in level one, but the slides contained a verbal label describing the part name, operation, or phase, being explained on the audio program.

The third level of the instructional program variable was the verbal only slide set. The same audio program tape was used, but again the cues provided in the learning context were quite different than the level one and two instructional programs. The verbal only instructional program contained 37 slides, each slide presented a heart part name, or names, or phase names, as being described by the audio program. There was no visual information provided on the slides for level three, but the verbal labels were the same as those given in level two. So while, each of the three levels of the instructional program variable provided learners with the to-be-learned target information, heart part names/phase names, this information was provided with different cues given in the learning context. Therefore, while all three groups received the same to-be-learned target information, it is likely that they processed this information in different ways, contingent upon cues given in the learning context.

The second between subjects variable was the type of cue provided during testing. The first level of the test cue variable was the free recall test. As the name implies, in the free recall condition the subjects had to write down the names of the heart parts and phase names from memory. The second level of the test cue variable was the visually-cued recall test. Subjects in this group saw a set of color illustration slides of the heart. Each slide contained an arrow, or arrows, pointing to a heart part, or describing a heart phase. The subject had to write down the correct name of the part or phase that the arrow in the visual illustration slide pointed to. The third level of the test cue variable was the verbally-cued recall test. Subjects in this group saw a set of slides, with each slide containing a three letter cue of a heart part name or phase name. The three letter cue consisted of the first three letters of a heart part name. For example, for the heart part name Myocardium, the letters Myo would be given on the slide. Each of the testing conditions tested for the same objective — the attainment or memory of the heart part names or phase names. But each testing condition provided different external cues.

Subjects for the study were 81 freshmen from Ohio State University. Subjects received course credit in their beginning level psychology course for participation. Subjects signed up for the study, and names on the sign-up sheet were randomly distributed to each of the three levels of the instructional program variable. Each level of the instructional program variable was conducted during one day, but at different times.

Each of the instructional program level groups were given the same amount of time to interact with the heart instructional programs. After their program ended they were randomly distributed to testing condition. The three tests were conducted by the experimenters. Each test type group was given a maximum amount of time to respond. This was defined as the time needed for all persons to complete writing on their response sheets. Upon completion, subjects were given instructions to return in one week for the delayed testing variable.

Results and Conclusions

Data analysis has been conducted on the resulting data, using the results of the immediate testing level. The delayed testing data has since been collected, and will be analyzed and presented in a future research article by the authors. The resulting analysis of variance data is presented in Table 1, Part 1. Resulting means and standard deviations are presented in Table 1, Part 2.

Table 1, Part 1
Resulting Analysis of Variance Data

Source	Sums of Squares	Mean Squares	DF	F Ratio	Probability
Between Subjects					
Instructional Program Variable	200.07	100.03	2	4.390	0.016
Test Cue Variable	47.18	23.59	2	1.035	0.360
Interaction	319.62	79.90	4	3.507	0.011
Error	1640.66	22.78	72		

Table 1, Part 2
Resulting Means and Standard Deviations

	Free Recall Test	Visually-Cued Recall Test	Verbally-Cued Recall Test	
Visual with Label Slides Plus Audio Program	12.4 Sd=6.44	12.2 Sd=4.41	13.8 Sd=5.56	12.8
Visual Only Slide Set Plus Audio Program	7.1 Sd=3.17	12.9 Sd=3.44	8.3 Sd=3.67	9.4
Verbal Label Slides Plus Audio Program	9.7 Sd=5.39	6.2 Sd=5.33	12.7 Sd=4.5	9.5
	9.7	10.4	11.6	10.6

The resulting significant interaction between the instructional program variable and test cue variable [f,(2,72df)=3.507,p≤.01] finds support for the encoding specificity hypothesis in this study. The significant interaction is graphically displayed in Figure 7.

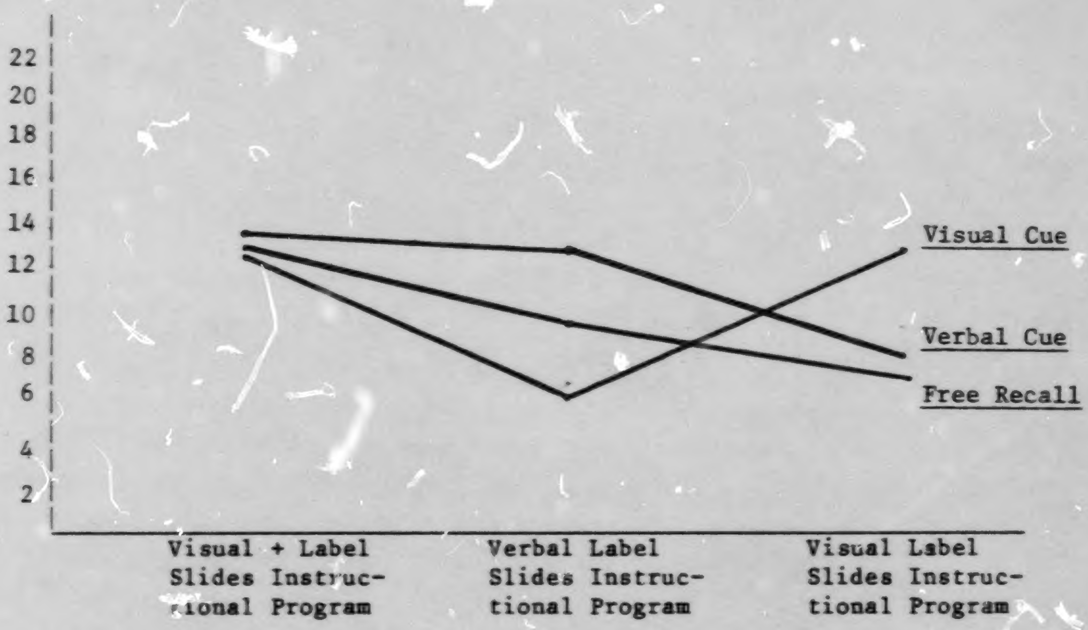

Figure 7: Significant Interaction Instruction x Test Cue.

As can be seen in Figure 7, and from the resulting pattern of simple effect means in Table 1, Part 2, test cue type and learning context cues, had a significant effect upon the ability to perform at the time of testing. In all three instructional conditions, the subjects received the same to-be-learned target information, in this case heart part names and phase names, but in different learning contexts. Each of the instructional programs provided different cues at the time of processing to-be-learned information. If a miss-match existed between type of cue provided during learning, and type of cue provided during testing, performance on the instructional objective debilitated, even though subjects had stored in memory the to-be-learned heart part names and phase names.

These results indicate that test performance can be significantly effected, either positively or negatively, by the type of cues given at the time of testing. In this case, if the inappropriate cue is given on the test, performance is not so much a matter of what the individual has learned, but more a result of the miss-match between learning context cues--the stored memory trace--and testing context cues. Therefore, while learning may have occurred in most learners, in a behavioral sense, inappropriate test cues will result in their demonstrated performance being a function of test cue type rather than acquired intellectual skills.

Preliminary data analysis and results have indicated that the refined experimental design has resulted in the typical cross-over interaction found in traditional encoding specificity studies in the psychological area (Figures 6 and 7). More importantly, these results were achieved using a classroom group learning situation, in which academic type content was presented, and testing took place in a classroom setting. These preliminary results indicate that cues provided in the instructional setting should be isomorphic to cues provided during testing. If visuals make up an important part of instruction, similar visual cues should be provided on the test. Similarly, if instruction is essentially verbal, spatial tasks on the test may be inappropriate. While this basic principle seems like a simple rule to follow, it is amazing that with all of our sophisticated methods of visualizing content testing still remains, for the most part, verbally oriented.

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Examining the Effects of Varied Computer-Based Reinforcement on Self-Esteem and Achievement: An Exploratory Study

by

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Running head: Reinforcement in CAI

Abstract

In the present study, the effects of judgmental and non-judgmental CAI on the self-esteem and mathematics achievement of remedial junior-high students were examined. Each of 44 students was given a self-esteem pretest. The subjects completed a basic mathematics facts drill and practice CAI program with varying degrees of judgmental feedback, and were posttested on the self-esteem scale. Although no statistically significant differences were found among the treatment groups, this result was more likely due to the short-term nature of the study, rather than an absence of a relationship between judgmental feedback and learner self-esteem.

Examining the Effects of Varied Computer-Based Reinforcement on Self-Esteem and Achievement: An Exploratory Study

There is considerable evidence to suggest that computer-assisted instruction (CAI) is a highly effective mode of delivery for instruction (Kulik ,1983). Several authors have shown that CAI is especially effective for self-motivated, high-achieving learners (Hoffman & Waters, 1982; Gershman & Sakamoto, 1981; Menis, Snyder, & Ben-Kohav, 1980). However, recent attempts to utilize computers with migrant and minority students have also been successful (Crandall, 1976; Saracho, 1982) In addition, other studies have shown that CAI can produce achievement gains when used with low achievers in basic skills areas (Suppes, 1981). Specifically, CAI drill and practice programs, used as "electronic flashcards" with these students has been effective (Charp, 1981; Edwards, Norton, Taylor, Weiss & Dusseldorp, 1975).

In a recent study on the effects of CAI on student attitude, the authors concluded that the children who participated in CAI programs believed the non-judgmental nature and the infinite patience of the computer made learning more pleasant than coentional instructional strategies, such as teacher-directed practice and discussion (Lawton

& Gerschner, 1982). The positive attitudes of these students were attributed to the fact that the computer provided consistent feedback, never showed signs of anger or frustration, and left the students with a general feeling of having learned "better" (Clement, 1981). Other authors have also found that students' attitudes towards CAI are generally positive (Caffarella, Cavert, Legum, Shtogren, & Wager, 1980; Duby & Giltrow, 1978; Garraway, 1974; Smith, 1973). However, the effects of CAI on broader affective traits, such as self-esteem has not been established.

One of the key benefits of CAI, however, may be the control of reinforcement, appropriate to the characteristics of the individual learner, and the corresponding lack of teacher criticism. During the past decade, the educational community has concentrated much attention on the effectiveness of conventional teacher praise as a reinforcer. Several researchers have shown that praise can be an effective reinforcer used consistently and appropriately (Heller & White, 1975; Lipe & Jung, 1971; Meyer, Bachmann, Biermann, Hempelmann, Ploger, & Spiller, 1979). However, Brophy (1981) noted that praise is rarely used in a systematic way to reinforce desired behavior. Several studies have supported Brophy's contention that teacher praise can often have deliterious effects on student performance. Such praise is inconsistently provided, and students tend to feel demeaned when they are praised for correct responses on tasks they view as simplistic or trivial (Bates, 1979; Meyer, et al., 1979; Silberman, 1969).

The effects of judgmental kinds of learner-computer interaction on the performance of low-achieving students requires further study. In addition, although much is known about the effects of teacher praise as a reinforcer in conventional classroom settings, little research has been done on the effects of positive and negative reinforcement in CAI, where the interaction can be controlled more or less absolutely. In this study, the effects of various types of reinforcements on both learner achievement and the self-esteem of low-achieving students were studied.

Methods

Subjects

The subjects of this study were 44 eighth grade mathematics students, drawn from three remedial mathematics courses. Placement in these courses was based on teacher recommendations and standardized test score results. The average Comprehensive Test of Basic Skills mathematics score for students in this study was the 39th percentile. The ethnic composition of the study group was primarily Anglo, with a minority of Hispanic and Black students.

Materials

Four CAI treatments were employed. The basic CAI program consisted of three sets of 10 randomly generated, multiplication fact drill and practice problems, with factors ranging from one to nine. After a brief, personalized introduction, the computer alerted the student to prepare for an upcoming problem and then "flashed" the problem across the screen in low-resolution graphics for approximately one second. The students were then shown the entire problem in regular computer text for approximately three seconds. For example, a typical problem might be: "8 X 8 = ?" The computer then prompted the student with, "The answer is ?" At this point, the student entered the answer and the computer displayed the correct answ for approximately 5 seconds. The students were the told to prepare for the next problem, whereupon the computer repeated the above procedure. The program was entirely computer-paced, displaying the problems and prompts at pre-defined rates, which the learner was unable to change. The program was modified to include four levels of systematic feedback.

Affirmation of response only. For the purposes of this study, affirmation of response refers to notifying the learner of the correct response, without any feedback as to the nature (correct or incorrect) of the learner's response.

Affirmation plus positive reinforcement for correct response. Students were notified of the correct answer and systematically praised by the computer for giving the correct response. In this program, the positive reinforcement nsisted of the computer displaying a happy face, ringing a bell and displaying the word "right" in bold green print. No feedback was provided to the learner when the incorrect response was given.

Affirmation with negative reinforcement for incorrect response. Learners were provided with the correct response and systematic negative reinforcement when the incorrect answer was given. Negative reinforcement consisted of the computer displaying a frowning face, sounding a buzzer and displaying the word "wrong" in bold, red print. No feedback was provided to the learner when the correct response was given.

Affirmation plus positive and negative reinforcement. This feedback version was a combination of the latter two treatments.

Depeant Measures

In addition to the four levels of CAI treatments described, the students were assessed on their achievement and their self-esteem.

Achievement measure. The number of correct responses provided by the learner for each of the three sets of 10 problems of the CAI program was recorded on magnetic disk. Validity of the CAI performance measure was established through expert review and comparison with print-based tests of multiplication fact mastery.

Self-esteem questionnaire. Prior to the CAI treatment, a pencil-and-paper Likert-type self-esteem questionnaire, developed by the author, was administered to the students This scale consisted of three parts. The first of the three parts contained 12 items and focused on the students' mathematics-related self-esteem. For example, the student was asked to rate statemen such as "I try hard in math" on a five-point scale, ranging from "all of the time" to "not at all." The second part of the scale contained 16 items and concerned general self-esteem questions such as "I get along well at home" and "I am popular." The third part of the questionnaire contained 8 items addressed the students' self-esteem relative to using the computer itself. Typical questions from this section were "I am smart enough to learn about computers" and "I am not afraid about working with computers." Each section of the scale utilized the same type of response format. The reliability of the self-esteem questionnaire was 0.87, using test-retest data obtained prior to the study. Validity of this measure was also established through coultation with experts in the field.

Procedure

After the subjects were pretested for initial levels of self-esteem using the self-esteem questionnaire, they were designated as relatively high or low in achievement and randomly assigned to one of the four treatment groups. The students then completed three sets of 10 problems. Scores from each of the sets were recorded. After completion of the CAI treatment, the subjects were postested for self-esteem using the same scale.

Experimental Design and Data Analysis

This experiment employed a completely crossed, 4 x 2 factoral design, featuring four levels of feedback (affirmation of response, affirmation with positive reinforcement, affirmation with negative reinforcement, and affirmation with positive and negative reinforcement) and two levels of achievement, high and low (based on CTBS scores). Dependent measures included three measures of posttest self-esteem (general self-esteem, computer self-esteem, and mathematics self-esteem) and one measure of performance from each of three trials with a basic skills mathematics program.

Posttest self-esteem scores were analyzed with MANCOVA procedures, with pre-test self-esteem as the covariate. Achievement differences were also analyzed with MANOVA procedures for repeated measures designs.

Results

The means for the individual pretest self-esteem measures are contained in Table 1 and the means for the individual posttest self-esteem measures are contained in Table 2. The affirmation of response with negative reinforcement treatment consistently obtained the highest reported levels of self-esteem across each scale. However, although there is a general trend of improvement in computer-related self-esteem across all treatment groups, the differences among the treatment means within each scale were not statistically significant. In addition, there were no significant differences between high and low achievers.

The mean percentage of correct responses made during each of the three trials of the CAI program are contained in Table 2. The performance across treatments was uniformly high on all trials, averaging over 90 percent accuracy for both high and low levels of prior achievement. No significant diffences among the means were found for either CAI treatment or prior achievement level.

INSERT TABLES 1, 2, AND 3 ABOUT HERE.

Discussion

The purpose of this study was to examine the relationship between the judgmental nature of CAI feedback used and the resulting achievement and self-esteem of learners. While no significant differences were found, several important points warrant discussion.

The tentative hypothesis that non-judgmental, or neutral, feedback in CAI would produce the most favorable attitudes, and correspondingly, the highest levels of learner self-esteem was not supported by this study. This belief evolved from research in conventional instruction, which indicates that neutral feedback, as opposed to positive or negative reinforcement, produces the highest levels of achievement and motivation, when the learning task is simplistic in nature (Bates, 1979; Brophy, 1981; Meyer, et. al., 1979; Silberman, 1969). Although not supported in the present study, this lack of support may be due to the short-term nature of the study, ratr than an absence of the relationship itself.
Self-esteem is the product of many factors, including environmental factors such as family and friendships, and personal characteristics

such as attitude. An individual's level of self-esteem is determined through years of development. The participants in this study were subjected to the experimental program for only two instructional periods, for a total of approximately 90 minutes, with the actual treatment varying in time between 10 and 30 minutes. It is unlikely that any short-term change in instructional strategy, even those utilizing the bias-free capabilities of the computer, could produce noticeable changes in accumulated levels of self-esteem. The results of this study reinforce the strength of self-esteem as an evolved trait, in that no significant changes could be fostered through relatively short interventions.

While no differences were produced in the brief time-frame used in this study it is possible that longer term interventions might prove effective. One might expect that high levels of self-esteem, as well as low levels of self-esteemare cultivated through proper learning experiences and manipulations of the individual's environment. If so, then perhaps self-esteem can be improved through the long-term use of planned positive, and controlled learning experiences. Computer-based instruction offers a potentially powerful tool in controlling the nature of the learner-instruction interaction, and perhaps the resulting self-esteem.

The underlying assumption of this study is that CAI, by its nature, is only as judgmental as the designer dictates. Computers can be programmed to be non-judgmental in their assessments of learner performance, since, unlike teachers, they possess no inherent emotions. Computers are only capable of displaying emotion that the programmer deems appropriate. Feedback that is demeaning, or subject to misinterpretation on the part of the student, can be avoided. Computers can be programmed to be completely consistent in their use of whatever reinforcement is necessary. Hence, CAI should be an ideal instructional delivery system icertain types of feedback and interactions are found to be destructive to the self-esteem of the individual learner.

Other factors may have hampered the present attempt to detect reliable, meaningful effects. There was an apparent "ceiling" effect on the self-esteem measures, leaving little room for improvement on the posttest. In addition, the CAI task, multiplication fact drill and practice, may have contributed to the ceiling effect, due to the simplicity of the task. Since subjects did very well on the drill and practice program, averaging over 90 percent in each of the four treatments, it seems probable that the negative reinforcement features of the treatments were rarely seen. The lack of negative reinforcement might well have contributed to the ceiling effects by causing the students to perceive the computer as a pleasant way to learn.

Some important general trends were detected in this study. For example, on the average, computer self-esteem scores improved somewhat for all the treatment groups, indicating that their attitudes towards CAI improved somewhat as a consequence of their exposure to the program (see Tables 1 and 2). In addition, students in the "affirmation of response only" and "affirmation plus negative reinforcement" treatments performed slightly better than the other treatments. When the absence of negative reinforcement caused by the ceiling effects is considered, this result is consistent with the notion that "affirmation of response" alone yields the highest levels of both achievement and self-esteem.

Because of the important pedagogical effects of learner self-esteem and the emergence of CAI as an important instructional delivery system, further study is warranted. The learning task used in the CAI program should be expanded to include both drill and practice and a tutorial segment that provide the basic instruction in a new skill or skills. This expansion would eliminate problems caused by the students being too faliar with the subject matter. Next, the self-esteem measures should be expanded in order to detect more subtle changes in learner self-esteem, by adding more items, eliminating item-overlap, and possibly adding a teacher observation portion to the scale. Finally, the time frame of the study itself should be lengthened, in order to examine longitudinal effects of CAI on learner self-esteem.

The purpose of this study was to determine if student self-esteem and achievement could be affected through the use of reinforcement in CAI. Although statistically significant differences among treatment groups were not found, some general trends were detected that should be explored with future research. Further research will help to establish the feasibility of the computer in providing reinforcement that will systematically improve learner attitudes, confidence, and overall self-esteem.

Author Identification Note

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Table 1. General, mathematics and computer pretest self-esteem means for high- and low-achievers in computer-assisted instruction.

	Type of Feedback				
Achievement Level	Affirmation of Response Only	Affirmation w/ Positive R	Affirmation w/ Negative R	Affirmation w/ Pos. & Neg. R	Total
			General Self-Esteem		
High	26.67 (n=3)	26.56 (n=5)	25.67 (n=3)	28.29 (n=7)	27.10 (n=18)
Low	25.33 (n=6)	26.20 (n=9)	26.67 (n=3)	27.43 (n=7)	26.39 (n=2
Total	26.22 (n=9)	26.43 (n=14)	26.17 (n=6)	27.86 (n=14)	26.69 (n=43)
			Mathematics Self-Esteem		
High	29.33	28.56	30.00	30.00	29.49
Low	27.33	27.20	29.57	25.00	26.90
Total	28.00	28.07	29.79	27.50	28.10
			Computer Self-Esteem		
High	31.33	27.00	27.00	24.29	26.67
Low	29.67	22.20	26.71	27.43	26.80
Total	30.78	25.29	26.86	25.86	26.28
			Total Self-Esteem		
High	87.33	82.12	82.67	82.58	83.26
Low	82.33	75.60	82.95	79.86	80.09
Total	85.00	79.79	82.82	81.22	81.07

Note: All cell sizes are identical to those listed under General Self-Esteem.

Table 2. General, mathematics and computer posttest self-esteem means for high- and low-achievers in computer-assisted instruction.

	Type of Feedback				
Achievement Level	Affirmation of Response Only	Affirmation w/ Positive R	Affirmation w/ Negative R	Affirmation w/ Pos. & Neg. R	Total
		General Self-Esteem			
High	28.67	29.40	31.67	28.14	29.17
	(n=3)	(n=5)	(n=3)	(n=7)	(n=18)
Low	26.00	27.78	28.00	28.71	27.64
	(n=6)	(n=9)	(n=3)	(n=7)	(n=25)
Total	26.89	28.36	29.83	28.43	28.28
	(n=9)	(n=14)	(n=6)	(n=14)	(n=43)
		Mathematics Self-Esteem			
High	32.67	31.80	33.67	29.14	31.22
Low	28.67	29.11	33.67	31.43	30.20
Total	30.00	30.07	33.67	30.29	30.63
		Computer Self-Esteem			
High	33.67	30.20	25.33	30.43	30.06
Low	30.50	28.56	33.00	25.86	28.80
Total	31.56	29.14	29.17	28.14	29.33
		Total Self-Esteem			
High	95.00	91.40	90.67	87.71	90.44
Low	85.17	85.44	94.67	86.00	86.64
Total	88.44	87.57	92.67	86.86	88.23

Note: All cell sizes are identical to those listed under General Self-Esteem.

Table 3. Achievement means for high- and low-achievers in computer-assisted instruction.

	Type of Feedback				
Achievement Level	Affirmation of Response Only	Affirmation w/ Positive R	Affirmation w/ Negative R	Affirmation w/ Pos. & Neg. R	Total
			Trial One		
High	96.67 (n=3)	91.11 (n=5)	93.33 (n=3)	92.86 (n=7)	93.09 (n=18)
Low	96.67 (n=6)	86.00 (n=9)	83.33 (n=3)	82.86 (n=7)	87.36 (n=25)
Total	96.67 (n=9)	87.82 (n=14)	88.33 (n=6)	87.86 (n=14)	89.76 (n=43)
			Trial Two		
High	95.00	94.44	96.67	88.57	92.62
Low	90.00	92.00	96.67	92.86	92.32
Total	91.67	92.87	96.67	90.72	92.44
			Trial Three		
High	96.67	94.44	100.0	95.47	96.13
Low	92.22	92.87	96.67	93.57	93.45
Total	92.22	92.87	96.67	93.57	93.45
			Total Achievement		
High	96.11	93.33	96.67	92.30	93.95
Low	92.22	90.00	91.11	89.05	90.40
Total	94.17	91.67	93.89	90.68	91.89

Note: All cell sizes are identical to those listed under Trial One.

The Relationship of Film Theory to Instructional Television

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The Relationship of Film Theory to Instructional Television

INTRODUCTION:

Media vidistics scholar Martin Perlmutter (1981) has noted in an essay on the language of television:

> It is easy to suppose that television is electric film. It is also probably wrong, and certainly unscientific, to simply assume so and make no further inquiry (p. 417).

Whereas most informed media theorists and practitioners could scarcely argue with such a proclamation in light of current semiological discourse methodologies, instructional television production practices, partially based on instructional designs, may not acknowledging this distinction (Clark and Salomon, 1984).

As a media consultant at the University of Wisconsin-Madison, I am constantly in contact with instructional design models that only recognize differences between film and television as resultant of how each media viscerally accommodate learner characteristics and task requirements (Romiszowski, 1981). These distinctions are of value when forging designs because they keep pedagogical considerations prominent. However, at the level of presentation, where all formats and forms are engendered by culture, and historically interpreted by spectators, the differences between these two media far exceed simple distinctions of learning capabilities and task analyses. Furthermore, the range of conditions far surpass screen size and resolution, or the ability to control a scan function button. These conditions include a cultural context for the production, distribution, and reception of film and television presentational forms (Ellis, 1982).

Since there is a disparity in the appropriation of terminology between the fields of educational media and communication arts and sciences, the terms format codes and presentational forms will be briefly outlined here. Format codes are culturally and historically articulated rules and sets of indentifiable elements that are manifested in film and television program types, such as news, sports, education, drama, variety, and advertising (Williams, 1974). Presentational form refers to the manner in which textual information is organized and represented. Presentational forms have specific "types" of articulations within the text. These articulations are evidenced in editing, camera angle, and any number of other presentational devices.

The main problem here is that differences in the format codes and presentational forms of film and television are recognized by media producers and spectators; yet, not by instructional designers (Reigeluth, 1983). John Ellis, in his book Visible Fictions (1982) argues that producers and spectators are not only aware of media differences, but that the production and viewing processes of television are acts of compliance:

> Broadcast TV can thus be seen as having a distinctive aesthetic, different from cinema. It offers relatively discrete and shot segments organised according to the patterns of repetition and innovation offered by the series and serial form, or merely into an agglomeration like a group of advertisements. These series forms are oriented towards the repetition of a basic dilemma rather than the resolution of an onward narrative movement. Often, the problematic that the series offers is that of vision itself: news and current affairs anchor themselves around the conception of the programme format as an eye roving across the world's events. The viewer tends to delegate his or her own look to the institution of TV. This delegation is made

> possible by the immediacy that the broadcast image claims for itself, despite the fact that almost all broadcasts are prerecorded. This immediacy, with its major form of direct address, and its dramas overwhelmingly concerned with notions of the domestic, can creat a sense of complicity between the TV viewer and institution. Both are in the home; the TV functions as a safe means of scanning the world outside (p. 170).

Through the production and reception of format codings, the relationship of the viewer to the institution of television perpetuates the legitimizing function of the medium as an ontologically correct, "meaning" producing agency. Based on the complicity of production and reception, presentational forms are utilized to perpetuate or reproduce this complicity and establish an aesthetic standard. According to Ellis, viewers and producers recognize media differences because they are aware of disparites in the appropriation of presentational forms, and the aesthetic standards associated with these forms, that represent their own relationship to the agency of production.

No matter how prescriptive the pedagogical coding of instructional television production processes, instructional designs generally do not acknowledge the complex presence of non-pedagogical codes, such as those borrowed from film, and how these codes might control and influence the "reading" of these texts. Whereas an instructional designer may only consider pedagogical codes on which to base presentational forms and their production specifications, instructional television producers are faced with a universe of codings infinitely more complex.

The aim of this inquiry is not to change current instructional design specifications for television production, but rather, to suggest how they may be extended into a more precise domain where forms of presentation may be cataloged and culturally defined. Differences between film and television can be identified in the utilization of presentational forms and their historical and cultural modes of production, distribution, and reception. Furthermore, ignoring these differences can confound, if not negate, the entire design process by neglecting a possible locus of control.

BACKGROUND:

At last year's meeting of the Society for Cinema Studies, Steve Lipkin (1984), in his presentation on how film and television interface, quite rightfully suggested that television analyses might be far better informed if someone were to cast an inquiry method in a mold similar to Noel Burch's Theory of Film Practice (1981), only applied to television. That is, a taxonomic examination of presentational forms and formats located in television programs. This suggestion is not completely novel in light of current formalist inquiries into television aesthetics, such as those forwarded by Herbert Zettl (1981). Moreover, methodologies for television analyses formulated in Great Britain by members of the Glasgow University group (eg. Stuart Hall), the Channel Four network, and media scholars such as John Fiske (1978), John Hartley (1978), Raymond Williams (1974), Albert Hunt (1981), Ann Kaplan (1983), and John Ellis (1982) have taken up this precise task of applying the more developed concepts of film theory to the analysis of instructional television.

In a recent issue of Screen (1984) magazine, television theorist, John Caughie, situates the historical development of television criticism and theory. He posits that Classic film theories, such as those created by Eisenstein (1949), Arnheim (1957), and Kracauer (1960), generally suffer from ontological essentialism in their search for an object of discourse. In the seventies, film theorists such as Metz (1974) and Wollen (1972) evoked cultural and sociological methodologies to mobilize semiology beyond this formal essentialism. It is at this point in history, and in this tradition, that television theory was developed and socio-cultural methodologies were adopted. However, Caughie notes that as the result of the different developmental periods in which film and television theories were forged, a disparity emerged. Namely, an object of discourse:

> Where dissatisfaction comes, I suppose, is finally with television theory's failure to engage dialectically with the film theory of the seventies. Rather than confronting its past productively, a great deal of television theory and criticism seems to be trying to reject the unwanted parent at the same time as tying itself to its terminological apron strings. The result is a very generalized, and sometimes quite inappropriate sense of discourses of television. We still don't really understand the very basic and specific formal operations of television within its programme categories: the organisation of look, continuity editing, the differences between mixing and editing, the construction of space, camera movement, sound and image (p. 119).

In otherwords, by placing television in a socio-cultural framework of representation before examining the formal operations of the medium, television theory has provided little in the way of analyses of presentational forms or other objects of discourse. This paper proposes to partially rectify this problem by utilizing a hybrid media analysis technique based on Burch's formalist film theory and Ellis television theory.

METHODOLOGY:

This inquiry proposes to facilitate Burch's formalist film theory to create an inductive comparative analysis technique by which to examine the utilization of presentational forms located in instructional television texts. Noting the current trend of media scholars applying film theory to the analyses of television, this inquiry will incorporate the television theory of John Ellis (1982) to contextualize the production, distribution, and reception of these presentational forms in a cultural framework. In otherwords, Burch's film theory, which identifies presentational forms, will be utilized as a tool for examining instructional television texts, while Ellis' television theory will be employed to examine Burch's methodology. This cross-referencing of film and television theory should create a checks-and-balances system for analyzing both the object of discourse and its cultural context. Finally, it will be suggested how the information generated by this inquiry technique might be facilitated in instructional designs.

INQUIRY METHOD:

Noel Burch, the founder of l' Institut de Formation Cinematographique, a French school of film theory and production, is generally considered by media scholars to be a formalist theorist because of his emphasis on presentational form and syntax in the production of the medium. Burch organizes his analysis technique to include six primary classifications: 1). dialectical parameters, 2). spatiotemporal articulations, 3). screen and off-screen space, 4). plastic interactions, 5). subject matter, and 6). perturbing factors. These six elements operate systematically and constitute the decoupage, or operational structure of presentational forms. Burch situates filmic form as dynamic; systematically complex.

Burch argues that there are foundation structures to film. Furthermore, these structures are always posed in dialectical opposition to each other, and apply to every presentational form. These dialectical parameters include legibility and duration. There is a dialectical relationship between what presentational forms are perceptible or imperceptible and expanded or contracted. For example, the longer (duration) a presentational form appears on the screen, the easier it is to identify it (legibility).

Other dialectics include photographic parameters such as soft or sharp focus, black or white shading, and monochrome or color film stock.

Burch also identifies organic dialectics such as absence or presence of image, intraframe movement or static central subject, backward or forward motion around a stationary image, fast or slow motion around normal velocity, live or animated subject matter, exterior or interior decor, and location or studio setting.

Narrative time constitutes yet another subcategory of dialectical parameters and designates presentational forms as past or present tense, temporally framed as flashbacks or flashforwards, and thematic or plastic variations.

Dialectical parameters also include the structural uses of sound as demonstrated by the formal presence of sound or silence, synchronous or asynchronous sound, and live or dubbed sound.

According to Burch, when a film is a completed unit that has achieved decoupage, presentational forms are organized in successions of *temporal* and *spatial articulations*. Temporal articulation refers to the organization of shot transitions. Spatial articulations refers to the manner in which the space represented by two shots in succession maintain or distort the continuity of the film. Burch emphasizes that all temporal articulations must be accompanied by spatial articulations of form. This is how the time/space relationship of film is represented. The convergence of spatial and temporal articulations generate patterns of *mutual inference*. Mutual inference refers to the set of of controlled spatial and temporal articulations that are formally presented at any given transition between shots. Burch proposes that there are five types of temporal articulations, which include the following: 1). *absolute temporal continuity*, 2). *time abridgement*, 3). *indefinite time ellipsis*, 4). *short time reversal*, and 5). *indefinite time reversal*. Each of these temporal articulations are accompanied by one of the three types of spatial articulations: 1). *absolute spatial continuity*, 2). *absence of spatial continuity*, and 3). *proximate* or *radical discontinuity*. By indexing temporal and spatial articulations, fifteen patterns of mutual inference can be identified.

The use of *screen and off-screen space* is another factor to be considered when identifying presentational forms in the filmic text. Space may be represented on the *surface of the screen*, but also, by what is not included in this presentational form. Off-screen space may be represented in film via directional vectors created by movements of the subject matter and apparatus. For example, off-screen space may be represented in a film when a character walks out of the frame; thus indicating to the spectator that there is space beyond the proscenium of the screen. Off-screen space may be *left*, *right*, *above*, *below*, and *behind* area projected on the screen, as well as the space occupied by the *camera*.

Burch suggests that the editing of shots in sequence not only generates spatial and temporal articulations, but also *plastic interactions between shots*. That is, the surface or material of the film fragments also effect the presentation of forms. Plastic interactions do *not* account for cinematic or narrative time and space. Rather, plastic interactions account for the real time and space in which film fragments are joined together. Burch identifies two types of plastic interactions: *static* and *dynamic*. A static articulation is created when a match-cut between two shots portrays the linked filmic material as inactive. Conversely, when one or both shots utilize the movements of fragments of film in the plastic process of editing, the articulation is dynamic.

Burch argues that much of film theory is centered around analyses of the *subject*. However, ~~these~~ theorists generally appropriate the subject to be a term for *theme* or *plot*. Burch rejects this use of the term and appropriates it in two different manners. First, the subject of a film is the material form or essential substance of discourse. Secondly, Burch refers to the subject as a generic term that describes "what" the structure of the film is used to represent. Therefore, the subject is both the material form or configuration of film fragments, and the structure that these fragments represent.

Film subjects may either be fictional or non-fictional. Fictional subjects are those that employ traditional dramatic narratives based on literary conditions. These conditions are used to evoke experiences that are interpreted by the viewer as being caused by an invariable relationship between the filmic discourse and "reality." Non-fiction film is possible only through the utilization of cinematic conditions of the subject to represent an abstract "reality." These cinematic conditions are employed to evoke experiences that are interpreted by the viewer as being caused by the presentational structure of the filmic discourse.

Burch notes that the formal domain of film can be altered by the presence of disruptive or perturbing factors. One element out of the filmic phenomenon out of place can render the entire continuity of presentational forms chaotic. Two perturbing factors are singled out by Burch to examine their confounding role in the production process: chance and structures of aggression. Chance refers to those disruptive elements that jeopardize the filmmaker's ability to control or regulate his production practices. Structures of aggression are those presentational forms that violate the tacit agreement between the screen and spectator to perpetuate a hypnotic condition, by producing, through discontinuity, surprise and discomfort.

In total, Burch's film theory represents a systematic method of cataloging presentational forms located in filmic texts and delineating how the interrelationships of these forms constitute the aesthetically communicative operations of this structure. The categorization of specific presentational forms enables the theory to inductively posit a generic conception of the medium, but not necessarily the only conception.

Utilizing this film theory to examine different media poses the problem of comparing dissimilar objects. Burch's film theory allows for a general media analysis technique by which to explore the objects of discourse, but it has no context in which to posit their relevance to television. In order to make Burch's film theory applicable to television, it must be situated in the context of television theory so that the modus operandi of Burch's own inquiry method may be scrutinized to determine if the production, distribution, and reception of presentational forms are operationally similar or dissimilar in both media.

John Ellis (1982) employs methodologies borrowed from film theory to address the relationship between the economic institutions that produce each medium, which he proposes influences the production of presentational forms. Ellis suggests that one such consequence of the economics of production is the historical mode of presentational form articulated in film as opposed to the live mode articulated in television. Ellis contends that the film spectator, via their cultural placement and consciousness of the mode in which films are produced and distributed, assumes that the diegetic events depicted in presentational forms have already occurred before the point of presentation. That is, the spectator assumes that the story has already occurred and that the medium is just neutrally recanting the tale. Television, on the other hand, never allows its narrative mode to come to a point of closure or resolution because of its utilization of serial presentational form, which is, of course, a direct reflection of its economic production and distribution. Sports programs, soap operas, situation comedies and the evening news all perpetually return to the tv screen hour-after-hour, day-after-day, and week-after-week. As a result of seriatum presentational forms, television is perceived as being continuous; even when programs are taken out of the context of this flow and presented in a classroom situation (Williams, 1974). The viewing pattern of television is established by thousands of hours of home viewing; not one discrete classroom showing.

In addition, for Ellis, the relationship of the sound and image of television to narrative form is also resultant of the complex relationships between media producing institutions and viewers:

> Broadcast TV characteristically offers an image that is stripped down, with no unnecessary details. Cutting produces forms of variation of visual information, and sound has an important role in drawing the viewer's attention back to the screen. The image and sound both tend to create a sense of immediacy, which produces a kind of complicity between the viewer and the TV institution. This can provide a powerful form of consensus, since it tends to define the domestic place of the TV set as a kind of norm, against which the 'outside world' represented on TV can be measured. This regime of image and sound, together with the segment and series forms, has created a distinct form of narration in broadcast TV (p. 144).
>
> This broadcast TV form of narration proposes itself to a particular kind of viewer, a viewer relaxing at home. It makes certain assumption, more or less unwarrented, about this viewer, and proposes a particular kind of position of viewing for the viewer. This form of viewing attitude has the effect of sealing the consensus nature of broadcast TV (p. 159).

According to Ellis, all presentational forms in television are utilized by dominant institutions of production to direct, through the use of narrative, the communicative or meaning-making relationship of the agency of the medium and the viewer; thus, maintaining perceptions that TV is a consensus form; a "democratic window" to the world. Therefore, presentational forms are generated to provide codings that perpetuate social and cultural relationships. In otherwords, Ellis' television theory is intertextual; it is used to examine the relationship of the text to its cultural and social context. On the otherhand, Burch's film theory is intratextual; it is used to examine the relationships of presentational forms that are operative within the text. Ellis, like cultural theorist Terry Lovell (1980), situates the text and its utilization of presentational forms as the product of complicity. In contrast, Burch situates the text in its use of presentational forms as the result of aesthetic and poetic contradictions implict in the organization of form.

In practice, Burch's categories would be used to analyze specific instructional television texts. The utilization of presentational forms located in the texts would then be documented and categorized. These forms would then be examined in light of their context, as figured by Ellis' television theory. This matrice of Burch and Ellis will hopefully allow for both intertextual and intratextual analyses.

TEST APPLICATION:

To test this inquiry technique, I chose an instructional television program entitled "Supervisory Skills Assessment." It was designed by Dr. Geraldine Markel (1983) and produced by Instructional Strategy Services at the University of Michigan-Ann Arbor.

It should be noted here that in light of time restraints, this test inquiry will be at best terse. It is presented here merely to give you an idea of how this inquiry technique operates.

The program utilizes a wide array of presentational forms. They are summarized as follows: dialectical parameters display a definite tendency toward perceptibility, expansion, sharp focus, neither black or white shading, color, presence of image, static central subject, forward motion, live subject, interior decor, present tense, neither flashback or flashforward, thematic variations, and synchronous sound, both live and dubbed.

In addition, spatiotemporal articulations between shots generally employ absolute temporal continuity, with a few time abridgements, as well as absolute spatial continuity within scenes, and absence of spatial continuity between scenes.

On-screen space is most commonly utilized in this ITV program. Off-screen space is rarely represented.

Without exception, all plastic interactions between shots are static articulations.

The subject matter type is fictional since this particular ITV program utilizes presentational forms as representations of realty and not the medium itself.

Finally, there is little evidence of chance or structures of aggression in this program, save a few lens refractions and mid-day shadows.

Whereas it is impossible to infer from one test analysis that ITV utilizes presentational forms that are similar or dissimilar to those utilized by film, as posited by Burch, there are some distinct patterns here that might be addressed by Ellis' contextual theory of television. For example, this program displays a definite tendency towards the zero point of style. That is, the utilization of codes that perpetuate historical and cultural continuity via the use of presentational forms. These forms maintain a perceived transparent relationship between the medium and reality. The program does not employ novel codes that might implicate its structural method of presentation. In otherwords, this ITV program sticks to modes of presentation historically perpetuated by film, and later, television. If programmatic inquiries indicated that utilization of these specific forms were historically perpetuated by instructional format codings, the resultant information would provide instructional designers with a means by which to maintain the status-quo of instruction or recast its trajectory via the manipulation of presentational forms.

Furthermore, and perhaps, more importantly, although there might appear to be a large overlap in the utilization of presentational forms by both film and television, Burch's formalist theory appropriates a descriptive method of inquiry that provides a description of "what" these forms are; not just a pedagogical prescription. This information allows the instructional developer to utilize each medium according to an entire range of presentational forms. A range, in its complexity, recognized by viewers.

CLOSING COMMENTS:

The cross-referencing of Burch's film theory and Ellis' television theory represents only one conception of a critical inquiry technique for the analysis of instructional television. In an effort to expand the critical base of this inquiry technique, other formative film theories, such as those posited by Eisenstein (1949) and Arnheim (1957), would be cross-referenced with television theories, such as those advanced by Williams (1974) and Fiske and Hartley (1978), might provide additional information about the relationship between the two media.

Program formats, such as news and sports, would then be contrasted for similarities and dissimilarities. In short, by cross-referencing these theories, a taxonomic conception of what forms are present in what texts under what conditions can begin to be formulated. It must be stressed here, that this type of inquiry is only the first step in a series of inquiries. As John Caughie (1984) has pointed out, programmatic research on how film and television interface will become increasingly important as both media are incorporated in new hybrid program forms, such as Home Box Office TV, and hi-tech movies, since these hybrid programs may utilize even more complex presentational forms.

Burch's film theory was forged to raise the consciousness of filmmakers in regard to how control of the medium may be obtained through the utilization of specific presentational forms. Curiously enough, control and regulation are also salient concerns of instructional design models. There is no apparent reason that the taxonomic information generated by this inquiry method could not be directly incorporated into production specifications, partially influenced by design models, for instructional television. The utilization of pedagogical codes may be aided or confounded by the utilization of television presentational forms. Therefore, it seems logical that these presentational forms be accounted for in order to more precisely regulate control of the medium, and thus, its ability to instruct.

QUESTION AND ANSWER PERIOD:

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Varied Self-Paced Micro-Computer Based Instructional Programs for Addressing Individual Differences When Acquiring Different Levels of Instructional Objectives

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Research Problem

The basic principle inherent in the design of micro-computer based instructional programs is the utilization of a self-paced instructional method. However, there are some indications that moderate levels of external and guided pacing may be more effective for learning in facilitating student performance levels, both in amount of content acquired, and instructional objectives levels attained. This hypothesis was tested in this study using three types of pacing, and evaluating learned competency on five achievement tests ranging in difficulty from memorizing facts to solving problems. Experimental results supported the hypothesis favoring moderate levels of external pacing, and concluded that the general assumption that permitting students to interact in a totally self-paced instructional environment, was not the most effective instructional method for facilitating student achievement for all types of micro-computer instruction.

Educational Technology and Attempts to Address Individual Differences

Researchers from a variety of different disciplines have considered the problem of learner individual differences and their influence on subsequent learning. A promising area of research which evolved to address individual differences of a cognitive nature was Aptitude Treatment Interaction (ATI) research. The general premise of the ATI effort was to propose fundamental predictions on how to design individual instructional treatments to address specific aptitude types (Cronbach, 1967; Cronbach and Snow, 1969). The ATI and Trait by Treatment Interaction research demonstrated that individual differences could be defined along the lines of a cognitive paradigm such as that proposed by Kagan, Moss and Sigel (1963). Each individual difference type could be characterized as a certain cognitive style, and varied instructional treatments might then be prepared to maximize the specific information processing capabilities of all the cognitive styles in a given group of students, in a given school curriculum. While theoretically valid, it does not take a great deal of effort to note that the practical aspects of such an instructional system would be tenuous at best. Unfortunately, the construct of individual learning differences remains a problem for teachers. Whether the individual difference variable is defined as genetic intelligence, as a cognitive style, or as an attitude, these individual difference characteristics have significant influences upon achieving various instructional objectives in the context of an academic learning environment. A more applied method of attempting to isolate and attend to individual differences has been through the design of instructional systems where learner control over the pace of instruction was permitted to vary as an independent variable. The value of self-paced instruction was pointed out by Carroll (1963) in his treatise defining aptitude as time required to learn to competency level. This treatise, of course, became the instructional system known as mastery learning (Block, 1971).

A number of other instructional systems have been designed around the idea of addressing individual differences by employing some type of an instructional system based upon learner control via self-paced instruction (Cross, 1976). The early research on programmed learning (Skinner, 1958) was based on the empirical benefits of errorless learning, immediate feedback, and self-pacing. The Personalized System of Instruction (PSI) developed by Keller (1974), and the Individually Prescribed Instruction System (IPI) developed by Glaser (1968) both have as their basis the benefits of self-pacing. Similar to the PSI and IPI instructional methods, Postlethwait's Audio Tutorial System (1974) is an attempt to address individual learning difference by self-pacing. Early work in the area of CAI adopted the principles of programmed learning, and therefore attempted to accommodate for individual differences by self-pacing (Atkinson, 1968). As educational technology has now advanced to the utilization of micro-computer based instructional strategies, the conclusion regarding the benefits of designing micro-instructional systems to be self-paced, as a way of adjusting for individual learning differences, has been generally accepted by our field. However, there is some indication that external control may be more effective than learner control of pacing, in terms of learning achievement. For example, Gropper (1964) found that a fixed-paced method was more effective than self-paced alone. Similar results are reported by Reiser (1984), who found less procrastination in completing a learning task with a type of external control as opposed to complete learner control of progress pacing.

Arguments favoring moderate levels of external control of instructional program pacing can be found in Cognitive Psychology research, dealing with the psychological variables of attention and motivation. In discussing his generative learning model based upon current findings from cognitive psychology, Wittrock (1978, p.9) cites four key factors directly effecting learning: "(1) Semantic and abstractive processes in memory, such as schemata, rules, and algorithms; (2) distinctive or episodic memories, such as images or verbal memories; (3) attention, and (4) motivation." From Wittrock's position, two key elements directly affecting learning, at a cognitive information processing level, are attention and motivation. It is likely that locus of control over instructional program pacing will have a direct effect upon attending behavior and motivation, at a psychological information processing level. In other words, if moderate external pacing of an instructional program can increase attention and motivation at a basic psychological level, the learner should acquire more information in less time than in self-paced instructional programs. The Zeigarnick Effect and Ovsiankina Effect have revealed that increased levels of psychological motivation on problem solving tasks tend to improve memory and transfer beyond the original learning tasks (DeCecco, 1963). Similar effects on motivation and attending behavior are found with the Yerkes-Dodson Law (Travers, 1972), yielding results indicating that moderate levels of motivation improve memory and intellectual skill performance. It is likely that the self-paced instructional method may not be the most appropriate instructional approach for all possible applications of CAI using micro-computer based instruction, if attention and motivation are considered. In a recent literature review on the topic of learner control over instruction, Carrier indicated similar conclusions regarding amount and order of instruction (Carrier, 1984, p.17):

"Many CAI designers assume that by exploiting the technical capabilities of the computer, they can increase student learning. For at least one of these technical capabilities—allowing students to exercise their own judgment about how much instruction they need or in what order—this assumption appears to be premature. There is little support from the research literature that offering students control will lead to increased learning (p. 17)."

The present study was conducted to test the experimental hypothesis that moderate levels of external pacing of a micro-computer instructional program would increase motivation and attending behavior and this would result in the more effective learning of instructional content, in terms of both the amount learned and level of competency performance using the learned content. A second hypothesis tested was that moderate levels of external pacing should improve the overall time efficiency of learning the instructional content. The third hypothesis was that higher achievers, as defined by the highest test scores on the five dependent measures, would opt for additional instruction, in the form of elaborate feedback, more than lower achievers on the five dependent measures. The third hypothesis would indicate that lower achieving students may not be in a position to opt for more instruction, but may require being forced into an elaborate feedback loop after a series of errors.

Experimental Design and Procedures

To test the first experimental hypothesis, a 4x5 Lindquist Type-I analysis of variance was used, having four between subjects levels and five within subjects levels. The between subjects factor was type of external pacing of the micro-computer instructional program, and its four levels were:

1. Self-paced program (SP),
2. Externally-paced program, normal reading speed, plus Cognitive processing time (EP+Cp)
3. Externally-paced program, normal reading speed, no Cognitive progressing time (EP-Cp),
4. Control.

The within subjects factor represented different levels of instructional objectives, defined as learning tasks. There were five levels of learning task, and they were called:

1. List learning task
2. Spatial learning task, Cued-recall
3. Simple Concept learning task
4. Complex Concept learning task
5. Spatial learning problem, free recall

The second hypothesis was tested by collecting time data on overall time to complete the instructional programs by each subject and averaging across subjects. This data will be presented descriptively. The third hypothesis was tested by collecting the number of options for feedback on each subject working through the instructional programs. The top six test scores, in each pacing condition, were then defined as higher test achievers, and the low six test scorers in each pacing condition, were defined as lower test achievers. An analysis of variance was conducted between the high achievers opts for feedback and the low achievers opts for feedback, at each level of instructional program pacing.

Each of the three micro-computer instructional programs was designed to teach subjects about the parts and operation of the human heart during systolic and diastolic functioning. The instructional content was an adaptation of the original Dwyer (1967) stimulus materials. The instructional content in each of the three instructional programs and sequence of content was identical. Each instructional program contained 57 instructional segments which consisted of one or two frames (individual computer displays) of instruction describing the heart parts and heart functions. Each frame of instruction consisted of a visual with a verbal description and arrow, or arrows, pointing out the important information in that display. There were three types of visuals used in the instructional programs (Figure 1). Each instructional display consisted of some combination of one of the visuals and a verbal explanation (Figure 1). Each of the three micro-computer instructional programs making up the external pacing factor will be described in detail. The graphics and text were authored using Apple SuperPILOT. Verbal instruction was presented in each program, at a normal reading speed, (300 words/min.) although two programs are externally paced at the point of instruction and elaborate feedback.

(1) Self Paced Instructional Program

The SP instructional program is self-paced at the point of instruction and feedback. Each of the 57 instructional segments start with the heart drawing, then part or phase names appear, then an arrow, or arrows, followed by the instructional text. After each completed instructional display is generated, the learner has as much time as desired to study the instructional display. To move on, the learner presses the return key to receive an activity question. The instructional display is removed prior to the presentation of each of the 57 activity questions. The learner responds to the activity question by typing in the correct response. The program accepts not only the standard spelling for correct answers but plausible misspellings as well. If the correct response is entered, correct feedback is given in the form of simple feedback (i.e., right, correct, got it, etc.). If an incorrect answer is typed in, simple feedback is given that the response is incorrect. The student is then given the option of receiving elaborate feedback, which is the repeat of the instructional display. However, this feedback is completely optional; he or she can move to the next instructional display without feedback. A record was kept for each subject on the amount of feedback options taken. Both the instructional display and the elaborate feedback aspect of the instructional program were completely self-paced.

(2) Externally Paced Program plus Cognitive Processing Time

The EP+Cp instructional program is externally paced at the point of instruction and elaborate feedback. The 57 instructional displays are identical to the SP instructional condition; containing the same content, in the same order, with each display generated in the same way, and at the same rate. However, the external pacing begins after the instructional display is completed. After each instructional display is completed, the program times the student's interaction with the completed display at a pace of: (a) 1 second per each line of verbal instruction, plus 1 second; so for 5 lines, 6 seconds for reading are given; (b) 7 seconds for cognitive processing are then given, after 1 second per line, plus 1 second, time has elapsed;(c) after reading time and cognitive processing time has elapsed, the instructional display is removed from the terminal screen. To move ahead, the learner presses the return key to receive the activity question. The learner has as much time as required to respond. If the correct answer is entered, simple feedback is given and the student moves to the next instructional display. If the incorrect answer is typed in, simple feedback is given that indicates an incorrect answer. As in the SP condition, the learner is given the option of receiving elaborate feedback, which is the repeat of the instructional display containing the required answer. The elaborate feedback is optional; the learner can move to the next instructional display or take feedback. Feedback is a repeat of the instructional display and is timed the same way, not allowing self-paced elaborate feedback. Therefore, in the EP+Cp instructional program, both instruction and elaborate feedback are externally paced.

(3) Externally Paced, No Cognitive Processing Time

The EP-Cp instructional program is externally paced at the point of instruction and feedback. The 57 instructional segments are identical to the SP and EP+Cp instructional conditions; containing the same content, in the same order, with each display generated in the same way, and at the same rate. After each instructional display is completed, the program times the learner's interaction with the now completed display at a pace of:

(a) 1 second for each line of verbal instruction, plus 1 second (i.e., 5 lines of written instruction, 6 seconds of interaction allowed).

(b) After interaction time of 1 second per line plus 1 second passes, the instructional display is removed from the screen.
(c) Cognitive processing time of 7 seconds is not allowed in the EP-Cp instructional condition.

The 57 activity questions in the EP-Cp instructional condition are identical to the SP and EP+Cp conditions. The learner has as much time as needed to respond to the activity questions. As in the SP and EP+Cp conditions, simple feedback is given after the learner responds to the activity question. If an incorrect answer is given, the learner has the option of receiving elaborate feedback, or moving to the next frame of instruction. The elaborate feedback is a repeat of the instructional display containing the correct answer. However, the elaborate feedback is externally paced in the same way as the instructional display, thus not allowing self-pacing at the point of instruction and elaborate feedback.

(4) Control

To determine the base rate of the subject's pre-instructional program knowledge of heart physiology, a control group was randomly formed from the pool of 100 subjects participating in the study. The control group took the five tests, but received no instruction. The control group method was used, as opposed to a pre-test for all subjects, because it was felt that a pretest would serve as an advance organizer, and therefore add an unwanted intervening variable to the study.

The within subjects factor represented the different levels of objectives, or learning tasks, and consisted of the five achievement tests to evaluate the amount of information acquired and competency level with learned information. To do this, the five tests ranged in difficulty from a simple memory task to a more difficult problem solving task. Each of the five tests contained a total of 20 possible points, and will be described according to level of intellectual difficulty, simple to difficult.

(1) List Learning Task

The list learning task was a simple memory task, requiring the learner to list the names of the parts of the heart.

(2) Spatial Learning Task, Cued-Recall

The spatial learning task, cued-recall, consisted of 20 multiple choice items designed to test the spatial learning of heart part location. The test contained a line-drawing of the heart with numbers and arrows indicating where each part was located. The 20 test items appeared under the numbered drawing and required the subject to identify specific part locations.

(3) Simple Concept Learning Task

The simple concept learning task contained 20 multiple choice items. Each item provided in the item stem a description of a critical attribute about a heart part or operation. The learner selected the heart part or operation from the available choices.

(4) Complex Concept Learning Task

The complex concept learning task contained 20 multiple choice items. The items were complex in the sense that they involved "if-then" relationships of the parts of the heart during heart operation, or what could be defined as disjunctive concepts.

(5) Spatial Learning Problem, Free-Recall

The spatial learning problem, free recall was considered the most difficult of the five tasks. The learner had to prepare from memory a line drawing of the heart, with the parts in the correct location and labeled. Then the learner had to indicate blood flow through the heart pump system, by drawing a series of dotted lines connecting how the parts interact during heart operation.

Subjects participating in the study were first term freshmen enrolled at Ohio State University. There were 100 subjects that participated in the study, and they received course credit towards their final grade in freshmen psychology for their participation. Subjects were randomly distributed by the experimenters to the three instructional program conditions and the control. Each instructional program group had 25 subjects, and the control group contained 25 subjects. The control group took the five achievement tests the day before the rest of the study was conducted to establish a base rate on the subject pools' knowledge of heart physiology. As can be seen in Table 1, part II, the control failed to know the names of the parts of the heart or the heart part locations and functions. The controls acquired score on the three multiple choice tests is a function of random guessing. As can be seen by the controls overall average score of (4.43) points on the five achievement tasks, they were only able to score an average of (22%) across all tasks. Based on this result, it was determined that the subject pool had little prior knowledge of heart physiology. The study was conducted during the following day. Three two-hour time periods, over a period of one day, were blocked off for each of the three instructional program types, beginning with the SP group, followed by the EP+Cp group, and then the EP-Cp group. All three groups were given instructions that they would be working through a micro-computer instructional program on heart physiology. The groups were not aware of any differences in the programs, nor were they aware that opts for feedback and overall time for instructional program completion were being monitored. After these simple instructions were given, the subjects went to the micro-computer lab to work through their instructional programs. When they completed their instructional program, they returned to the classroom to take the five achievement tests. The two free recall tests were administered first to avoid subjects attaining cues from the multiple-choice tests. After completing the two free recall tests, the three multiple-choice tests were administered.

Resulting Data

Analysis of the resulting experimental data from the Lindquist Type-I design appears in Table I, part I, and the between subjects mean, within subjects mean and simple effect means are presented in Table I, part II.

The analysis of variance results in a significant F-ratio on the between subjects variable of instructional program pacing, [*F*(3,96 Df) = 45.875, *p* .001]. A Tukey follow-up test was conducted on the between subject means, with a significance level set at (.05). The three experimental group means [(SP,$\bar{X}$=10.57)(EP+Cp,$\bar{X}$=12.22)(EP-Cp,$\bar{X}$=9.02)] differ significantly from the control [C,$\bar{X}$=4.43]. The EP+Cp mean [$\bar{X}$=12.22] differs significantly from the EP-Cp mean [$\bar{X}$=9.02]. However, while the EP+Cp mean did not differ significantly from the SP mean, the EP+Cp mean is greater. The SP mean does not differ significantly from the EP-Cp mean.

The within subjects variable of task difficulty resulted in a significant F-ratio; however, there was a significant interaction between instructional program pacing and task difficulty [*F*(12,384 Df)=10.485, *p* .001]. To find the source of the interaction a Tukey follow-up test was used, set at a significance level of (.05). The significant interaction is graphically displayed in Figure 2. The source of the interaction is found in the EP+Cp instructional program condition. In the EP+Cp condition, as task difficulty increased across the first four achievement tests, the performance competency of the EP+Cp subjects remained constant. Even at the most difficult achievement test level, the spatial problem, the EP+Cp group performed significantly better than the EP-Cp group, and slightly better than the SP group. The SP group had a significant decrease in performance competency as task difficulty increased, yielding a significant decrease in performance between the complex concept task [$\bar{X}$=10.40], list learning task [$\bar{X}$=12.36], and spatial learning task, cued recall [$\bar{X}$=12.32]. Similar results occurred with the EP-Cp condition, finding a significant drop in performance between their list learn task mean [$\bar{X}$=11.84], and simple concept task and complex concept task means [($\bar{X}$=8.88);($\bar{X}$=9.48)].

Additionally, at the EP-Cp level, the spatial learning, cued-recall task mean [$\bar{X}$=10.64] differed significantly from the simple concept task mean [$\bar{X}$=8.88], and their performance competency on the spatial problem was quite low [$\bar{X}$=4.28].

The significant interaction finds support for the first hypothesis, indicating that moderate levels of external pacing of a micro-computer instructional program tended to allow for more content information to be attained, and allowed for a higher level of competency performance with learned information over a self-paced instructional program. Support is found for the second hypothesis, indicating that an externally paced instructional program would allow for more efficient learning than self-paced alone. Looking at the average time for completion of the three instructional programs (Table 1, part II) finds the EP+Cp group to be more efficient than the SP group [EP+Cp=44.64 min.; SP=50.36 min.; EP-Cp=45.04 min.].

In many micro-computer instructional programs, the learner is permitted to opt for elaborate feedback in the form of additional instruction. However, it is likely that higher test achievers will tend to opt for elaborate feedback more often than lower test achievers, even though lower achievers actually need the elaborate feedback or additional instruction more than their higher achieving counterparts. This, of course, would indicate that learner control over needed additional instruction may not be appropriate. The third hypothesis was tested by comparing opts for feedback of higher achievers on the five tasks, as defined by the six subjects having the highest test scores in each pacing condition, and the lower achiever opts for feedback. Lower achievers were defined as the six subjects in each instructional pacing condition with the lowest achievement test scores. An analysis of variance was conducted comparing opts for feedback between higher achievers and lower achievers, at each of the instructional pacing conditions. The resulting analysis is summarized in Table 2. A significant F-ratio occurred on the feedback opts variable [F(1,30 Df)=192.47, p .0001]. This result supported hypothesis three, finding that those subjects defined as higher achievers selected elaborate feedback, ($\bar{X}$=86.56%) of the time, when an error was made on an activity question during instruction. Those subjects defined as lower achievers selected elaborate feedback ($\bar{X}$=29.72%) of the time, when an error was made on an activity question during instruction.

Discussion of Resulting Data

Results of the present study indicate that self-paced instructional methods for micro-computer based instructional programs (MCBI) may not always be the best method of addressing individual learning differences. The decision is often made by instructional specialists working with MCBI to build instructional programs to be self-paced, simply because the micro-computer is well adept at self-pacing. Additionally, many of the past efforts at accommodating for individual learning differences, have been to design instructional systems around the relative benefits of self-pacing (Cross, 1976). However, when considering a cognitive psychology paradigm of improving learning, the variables of attention and motivation should not be ignored. Since attending behavior and motivation are key psychological elements in the learning process (Wittrock, 1979), it is likely that by manipulating these variables, learning outcomes can be changed.

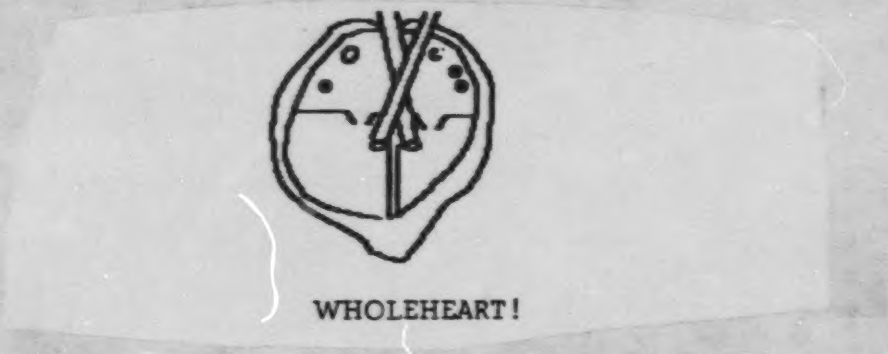
The present study demonstrated that during a self-paced instructional program subjects behaved differently, in terms of amount learned and performance competency with learned material, than subjects in a moderate externally paced instructional program condition. It is likely that this element of moderate external pacing caused subjects in this condition to be more motivated to interact with each instructional display and attend to information in each display more carefully. The EP+Cp instructional program condition caused a significant increase in learning and performance competency, even on the more difficult tasks. This result indicates that moderate levels of external pacing can improve overall learning, and that self-pacing may not always be the best methodology for MCBI. However, learning performance was significantly impaired by eliminating the 7 seconds of cognitive processing time in the EP-Cp instructional program condition. Apparently, this slight change in pacing increased motivation to a point where cognitive information processing deteriorated. This fits the Yerkes-Dodson Law quite well (Travers, 1972), and indicates that moderate external pacing is defined as external pacing allowing a reasonable amount of time for mental interaction with the generated instructional display. In other words, external pacing can increase attending and motivation resulting in improved learning, but it cannot be too extreme.

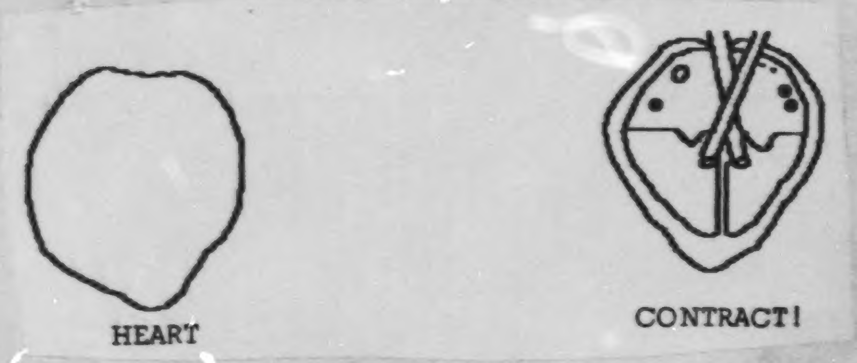
On the issue of opting for elaborate feedback, or additional instruction, it would seem that the students that may need elaborate feedback the most, are those less likely to opt for it. This result fits Carrier's (1984) conclusion that students may not be the best judges of what instruction they need, and how much instruction they need, for effective learning to take place. However, many instructional designers build MCBI programs that may have elaborate feedback available, but only recommend to learners that such feedback is needed. It may be necessary to force learners into elaborate feedback loops, or remedial instruction loops, if they are making a significant amount of errors on activity questions or instruction post tests.

Conclusion

The purpose of this study was to investigate the axiom that when learners are permitted to interact with self-paced instructional materials, for as long as is perceived necessary to acquire academic content materials, learning will be optimum. Results obtained from this study provide evidence which indicates that when students are permitted to exercise freedom through instructional sequences, learning is not optimized. The data also yields evidence which shows that varied types of self-paced micro computer instructional strategies are not equally effective in facilitating student achievement of identical instructional objectives. Further, these results indicate that complete learner control over feedback, for micro computer instructional programs, should be used with caution since one cannot assume that students who require further instruction will actually engage in further instructional work via branching options or elaborate feedback options.

External pacing of MCBI applications should be investigated further, using different types of academic content and different types of instructional objectives. Additionally, a variety of external pacing methods should be considered for MCBI learning systems, and the effect of these methods should be evaluated on learners with different cognitive styles (i.e., field-dependents-independents, reflectives-impulsives, etc.).


WHOLEHEART!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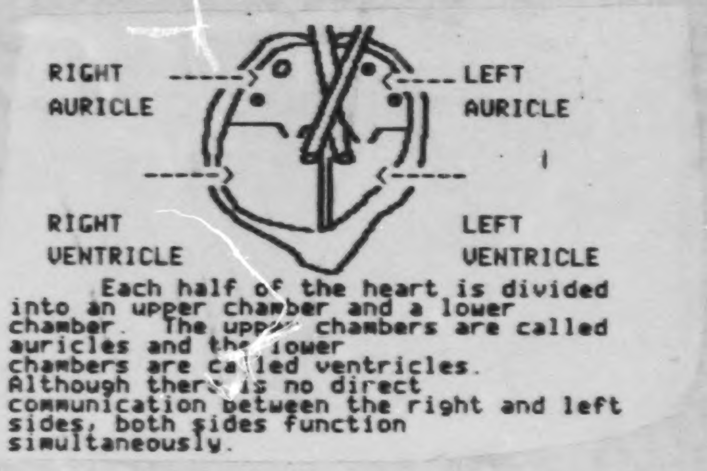
RIGHT AURICLE
LEFT AURICLE
RIGHT VENTRICLE
LEFT VENTRICLE

Each half of the heart is divided into an upper chamber and a lower chamber. The upper chambers are called auricles and the lower chambers are called ventricles. Although there is no direct communication between the right and left sides, both sides function simultaneously.

Figure 1: Heart Visual Types, and Sample Instructional Display.

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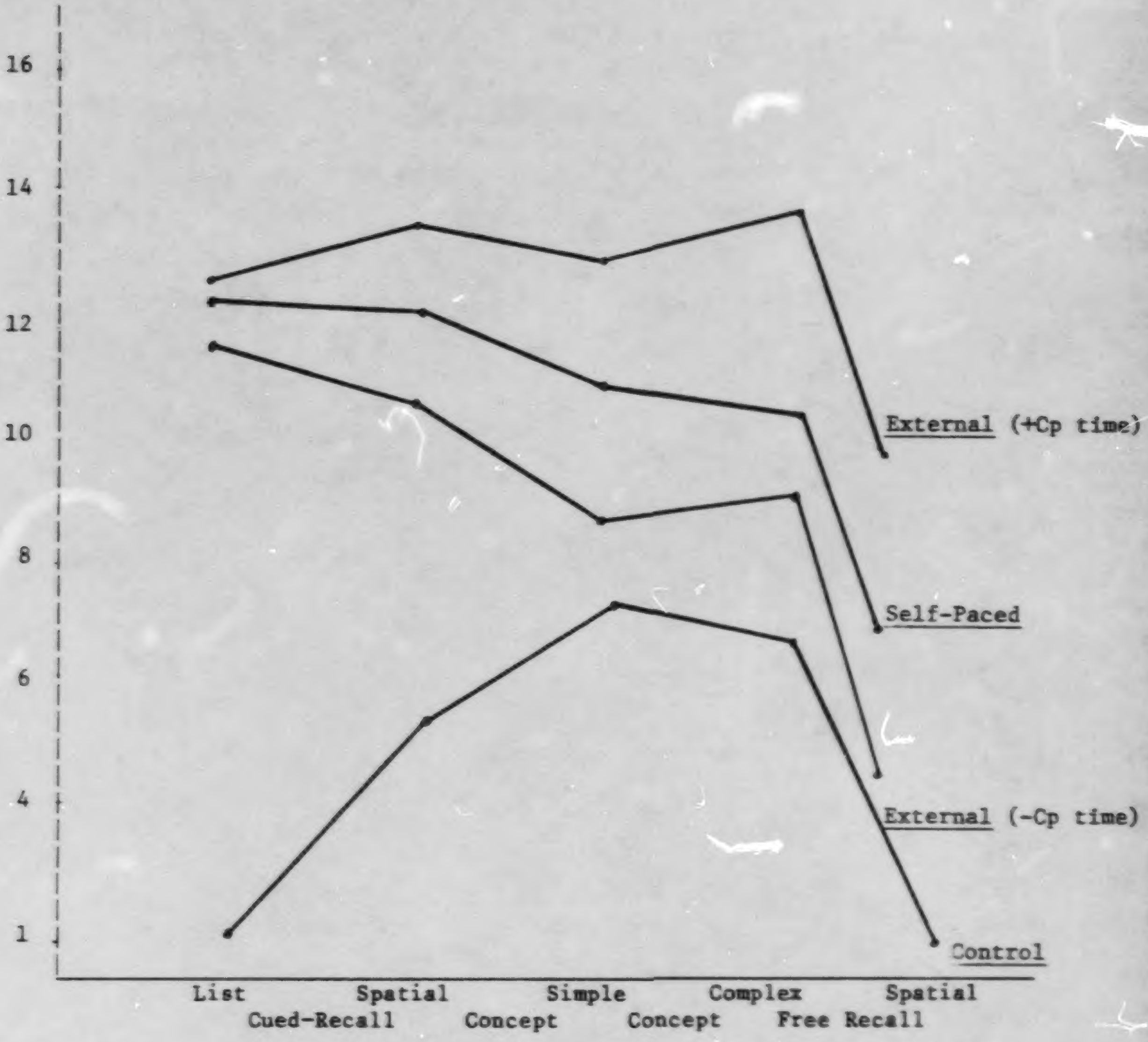

Figure 2: Graph of Significant Pacing by Learning Task Difficulty Interaction

Source	Mean Sq.	Df	F-ratio	Probability
BETWEEN GROUPS				
Pacing (A)	1404.359	3	45.875	.001
Error	30.613	96	—	
WITHIN GROUPS				
Learning Task Diff (B)	493.917	4	99.785	.001
(A) x (B)	51.901	12	10.485	.001
Error	4.949	384	—	

Table 1, Part I: Lindquist Type-I Resulting Data.

	Self-Paced	External Pace, Norm Reading Speed + Cp	External Pace No Cp	Control	WG, $\bar{X}$.. Control In
List Parts (List Learning)	12.36	12.48	11.84	1.92	9.65
Spatial Learning, Cued-Rcall	12.32	13.60	10.64	5.68	10.56
Simple Concept Learning	11.00	12.80	8.88	7.12	9.95
Complex Concept Learning	10.40	13.64	9.48	6.56	10.02
Spatial Learning Problem, Free-Rcall	6.76	8.60	4.28	.88	5.13
BG, $\bar{X}$ ..	10.57	12.22	9.02	4.43	
Avg. Time Overall	50.36 min.	44.64 min.	45.04 min.	n/a	

Table 1, Part II: Resulting Means and Overall Time to Complete Instructional Program

Source	Mean Sq.	Df.	F-ratio	Probability
Between Groups				
Pacing (A)	241.861	2	1.6	.22
Feedback Opts (B)	29070.25	1	192.47	.0001
(A) x (B)	86.583	2	.57	.57
Error	151.039	30		

Significant Means High 6 vs. Low 6:
Feedback Opts, High 6 ($\bar{X}$=86.56%),

Feedback Opts, Low 6 ($\bar{X}$=29.72%)

Table 2: Anova results on feedback options of hightest scoring 6 and lowest scoring 6 and significant means.

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Using Video to Study Cognition

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Using Video to Study Cognition

Piaget's (1977) new model of equilibration has engendered a move among cognitive psychologists towards functionalism, incorporating a study of microdevelopment, rather than macrodevelopment, and focusing on problem solving strategies and compensations, rather than stages. Three aspects inherent in the learning process have been expanded from the earlier model and detailed: (1) self-regulation, (2) conflict resolution, and (3) reflexive abstraction.

Aspects Inherent in Learning

Self-regulation

Self-regulation refers to the active processes of assimilation and accommodation. As biological organisms, learners are constantly restructuring and adapting. They make relations and inferences about actions and events and then test out these inferences in an attempt to make meaning out of the world.

According to Kuhn and Ho (1977) the importance of self-regulation has probably been underestimated by educators. These researchers asked children to determine an unknown variable in the basic isolation of chemical task. Some children were allowed to plan their own sequence of steps, in effect to test out their own hypotheses. Others served as yoke controls and were required to do the same steps as their yoke. In other words, the experimental group decided what chemicals to mix in order to determine the correct combination of elements in Beaker x. The control group was told by the researchers which chemicals to mix, the directions determined by whatever actions were performed by the yoke in the experimental group. Hence the

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subjects in the control group performed the identical actions but they could not test their own hypotheses. Higher level strategies were found to exist on a similar task serving as a posttest for those subjects allowed to test their own hypotheses.

Conflict Resolution

A study by Karmiloff-Smith and Inhelder (1974) illustrates the importance of conflict resolution. These researchers studied children's construction of theories about balance by giving children (ages 3-7 years) symmetrical blocks, asymmetrical blocks, and blocks with hidden weights to balance on a fulcrum. They found that the youngest children's actions were representative of their egocentric schemes. They just "plunked" each block on the fulcrum, with no lateral shifts across the fulcrum to find the balance point. Their compensations, when blocks did not balance, consisted of claiming that the block was an impossible block to balance or of pushing harder on the block above the point of contact with the fulcrum. Since these actions obviously did not produce success, children began to explore the properties of the blocks and to try different positions on the fulcrum. Reflection on these actions brought about a focus on the procedures which worked (lateral shifts) and eventually the construction of a theory about balance which was assumed to work for all blocks. The first theory constructed was a "center" theory (find the middle of the block and it will balance). This theory was over-generalized across all blocks regardless of whether the block was asymmetrically weighted. In testing out their theories, children met with conflict. Eventually, through conflict resolution, more stable theories of balance in relation to weight were constructed.

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In a microanalysis of this data, Karmiloff-Smith and Inhelder found that children without a general theory were success-oriented and reflected only on actions and procedures which worked. In contrast, children who began with theories had a theory-testing orientation to the task and thus were led to either confirm or disconfirm their theories in action. This theory testing behavior led to the eventual construction of a new one. Even a wrong theory was more helpful than no theory in the long run. Hence, the title of their article, "If you want to get ahead, get a theory."

Reflexive Abstraction

The third process in learning identified by Piaget and the Genevan School is reflexive abstraction. This process is defined by Gallagher and Reid as:

> ".....the reflection process through which one derives information from one's own actions and from the coordination of actions (putting them into correspondences, linking them, and so forth). It provides the links between and among experiences and can be detected even in the very earliest and most elementary behavior of infants. Reflexive abstraction has two aspects: a projection from a lower to a higher level--for example, from the sensorimotor level to the level of thought--and a reorganization or reconstruction of knowledge at the higher level." (Gallagher and Reid, 1981, p. 235)

Piaget (1977) distinguishes reflexive abstraction from a lower level abstraction which he calls empirical abstraction. He defines empirical abstraction as the reflection occurring in relation to the observables of the

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objects. In the case of the blocks in the aformentioned study by Karmiloff-Smith and Inhelder, the empirical abstractions would be in relation to the size, shape, weight of the block. In contrast, reflexive abstraction pertains to the reflection which generates theories about balance in general. Of most importance, however, is the fact that empirical abstractions lead to reflexive abstractions. In Piaget's model, reflection is seen as a spiralling process, each reflection bringing the learner to higher levels.

The Problem

While these aspects of learning have been well delineated by Piaget, they have rarely been empirically and/or statistically validated. A microanalysis of the compensations of a few subjects has usually been deemed sufficient.

Current technology allows the researcher the opportunity to record and explore these aspects from a naturalistic paradigm and then to test them in an empirical fashion. For example, video affords the researcher the ability to film individually a large number of subjects of different ages solving a problem. These film clips can then be analyzed microanalytically using stop-action, fast forward, and replay to illuminate the regulations of the subjects. Hypotheses can then be made and tested statistically.

The remainder of this paper is the report of a study using stop-action video of a problem solving task with such an approach. The first part of this study is a replication, statistical validation, and extension of the Karmiloff-Smith and Inhelder study of balance. It's purpose was to provide empirical validation of the ordinal levels as psychologically discrete behaviors and as comprising a heirarchical scale.

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Part I: Naturalistic Observations

Validation of Ordinal Scale

Method

Subjects

Sixty-four girls and 64 boys whose ages ranged from 48 to 96 months served as subjects in the study. The mean age of the group was 72 months.

Materials

Materials consisted of a 1/4 inch fulcrum raised along the length of a platform 6" x 10" and a series of blocks to be balanced, modified from the Karmiloff-Smith and Inhelder task. For purposes of scoring placement, the bottom plane of each block had five imaginary points. The blocks were further classified by clusters which were felt to invoke the same theoretical principle of balance (see Figure 1).

A group of "helper blocks" was also provided each subject to use as he/she wished. All helper blocks were painted blue, to contrast with the blocks for balancing which were painted green. There were six helper blocks in all: two 2-3/4 x 2-3/4 x 1-7/8 inches, one 1-3/8 x 1-3/8 x 1-7/8 inches, and two 5-1/2 x 2-3/4 x 1-7/8 inches.

Procedure

Each child was brought individually to a testing room (adjacent to the classroom) by a female experimenter. The child was seated at a low table with the blocks to be balanced placed to his/her right and the "helper blocks" to his/her left. The fulcrum was taped to the table in front of the

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child. The child was asked by the experimenter to try to balance each of the blocks, one at a time, on the fulcrum. After each block was tried it was removed so that the subject tried each block only once. Subjects were videotaped as they tried each block. Video equipment was obscured from the subject's view.

Measures

Strategy scale. A scale was drafted from an analysis of the Karmiloff-Smith and Inhelder study, assessing the degree to which the child's performance indicated a theory testing orientation to the task. The use of the helper blocks, direction of lateral corrections across the fulcrum, anticipation of the effect of such factors as area or weight, and the degree to which the child tested out his/her theories about balance were all factors taken into account in constructing this scale. The scale was refined through pilot testing and expanded to incorporate five construct levels comprised of 13 operationalized behaviors as follows:

Level 1. Egocentric

1.1 This behavior is characterized by an ego orientation to all the blocks. In other words the child believes that his/her actions should balance the block; blocks are placed at any point erratically on the fulcrum and let go, or pushed hard above the point of contact, or held horizontally in place. No lateral shifts across the fulcrum to find the center of gravity occur. In fact the child at this level frequently describes the block in terms of a seesaw, having an "up" and a "down" side. He/she pushes down on one side or holds the other side up but only one side at a time is the focus.

1.2 This behavior is still characterized by an egocentric orientation although it represents a beginning

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decentration off a reliance on the self to a focus on the block and its properties. Different dimensions of the block are tried as well as different points of contact with the fulcrum. In place of a hand, helper blocks are used under the block to be balanced in order to "hold the down side up." Even though the properties of the block are beginning to be questioned, no lateral movements, no rotations, occur.

Level 2. Visual Center of the Bottom Plane Theory (VCB)

2.1 Although a child on this level originally places the block on the fulcrum in an egocentric fashion, lateral shifts begin to occur. At first they are towards the midpoint of the bottom plane of the block. The child appears to be beginning to form a theory (general principle) about balance, e.g. all blocks will balance if you shift to the middle of the bottom plane of the blocks. The child does not yet have a stable "theory-in-action" but is beginning to test out variables that might produce success. As the child experiments with lateral movements, he/she discovers that the overhangs of the block are related. A shift can make the "up" side go down and the "down" side go up.

2.2 This behavior is demonstrative of the first real theory. The child believes the midpoint of the bottom plane of the block to be the exact point of balance. He/she in fact struggles through measurement or lateral corrections to find this point. The original placement is a VCB (visual center of the bottom plane) placement, with the expectation that this is the correct placement, rather than an ego

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oriented, random placement.

2.3 Although the child at this level still originally places the block at its VCB, since this strategy does not work for many of the blocks, the child begins to test out whether the visual center (midpoint) of the whole block (rather than the bottom plane) is a better theory. For example, blocks #1 and #2 have a VCB at point 2. This original placement will not successfully balance the blocks. The child shifts the block towards point 3.

Level 3. Visual Center Theory (VC)

3.1 The distinction between levels two and three is that, whereas the placements in level two were all around or at the VCB, the original placement at this level is a bisection of the whole block in order to find the midpoint. Specifically, at level two, blocks in clusters two and five were placed originally at point 2 and then shifted to point 3. By level three, the child is certain that the whole block must be bisected and thus places these specified blocks at point 3 originally.

3.2 This behavior is characterized by the use of helper blocks. However, this time they are placed on top of the block, rather than underneath for support. Importantly, they are placed on top of the "up" side to make the "down" side come up. This fact suggests that the child is testing whether adding a block to the main block will affect balance. Although helper blocks are used, all blocks are placed and remain at point 3.

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3.3 This behavior begins with an original VC placement but the child shifts the block towards the side with the greater area. Since the VC was the original placement this behavior is still classified as representative of a visual center theory. This behavior is most obvious with blocks #7,8,9,13, and 10. Interestingly, this action occurs even in block #10, even though these corrections are away from the obviously more heavily weighted side!

Level 4. Area Center Theory (AC)

4.1 This behavior suggests that the child has given up the insufficient theory about the visual center and now assumes that weight is a factor. However, weight is determined by visual cues; bigger space is assumed to weigh more. Original placements are toward the side with the greater area (e.g., point 2 on blocks #7, 8, 9, 13, 10). Since the child seems sure of this placement as the only "correct" one, all corrections consist of a struggle to find balance around point 2.

4.2 Here the child begins to question whether greater space is really analogous to greater weight. In the face of conflict, he/she reverts back to an earlier theory and uses the visual center as an anchor point. Corrections are made both towards the weighted side and the side with greater space, depending on the block. For example, Cluster 3 blocks are originally placed at point 3 and corrected towards point 2; Cluster 4 blocks, in contrast, are originally placed at point 3 and then corrected towards point 4.

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4.3 This behavior is characterized by a reaffirmation about the need to bisect the area of the block. Thus original placements are again at this bisection (point 2 for Cluster 3). Corrections are made, in contrast to 4.1 toward the more heavily weighted side.

Level 5. Weight Theory (WT)

5.1 Here the child has finally constructed a theory about weight and understands that it is the weight that must be bisected by the fulcrum. Thus, the original placement is an estimate of this bisection, point 4 on the weighted blocks. Corrections consist only of a struggle to find this midpoint.

5.2 This last behavior entails production. Because the child has a stable understanding of weight, he/she knows that helper blocks must be added to the impossible blocks (Cluster 5). He/she adds helper blocks and then makes the appropriate lateral shifts to find the balance point, evidence that the reciprocal nature of distance and weight is understood.

This ordinal scale was further operationalized in terms of expected behavior for each of the blocks thus defining an idealized profile for each level. For example, a child at level 2.2 (VCB) should place the length blocks at point 3 originally and struggle with this area searching for the midpoint. The displaced base blocks, in contrast, would be placed originally and corrected around the visual center of the bottom plane, point 2. The same placement would occur with the impossible blocks. With the asymmetrical and weighted blocks, point 3 again becomes the focus even though these attempts at balancing are unsuccessful. The child just deems these as "hard blocks."

Two raters, blind to the age of the child, viewed the video tapes and assigned each child to one of the 13 behavioral profiles. Since there were cases where children did not exhibit a perfect fit to any one of the 13 idealized profiles, the raters double coded 20% of all video tapes. The interrater reliability score was 86% based on the number of perfect matches divided by the number of subjects double coded.

Cluster Score

The blocks were categorized (see Figure 1) into clusters which ostensibly tapped the same level of understanding. For instance, Cluster 1 should be the easiest group of blocks to balance since each block could be balanced successfully with a theory about bisecting the base of the block. Cluster 2 tapped the abstraction of bisecting the whole block rather than just the base. Cluster 3, the asymmetrical blocks, should be passed by subjects holding a theory about area as analogous to weight. The weighted blocks, Cluster 4, should only be passed by subjects having an understanding about weight. Cluster 5, the impossible blocks, should be the most difficult cluster since it required an understanding of the need not only to add counterweight, but also to move the block on the fulcrum to equally balance that weight.

In order to alleviate the possibility that success could occur by chance this measure was made very stringent. Every block in the cluster had to be balanced successfully before the subject was coded as passing that respective cluster. It was assumed that for subjects to pass a cluster they had to make an inference about how the blocks in that cluster were alike and then struggle with them to find the exact balance point. Subjects were given a

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score of pass or fail on each cluster.

Results

Strategy Scale

The Spearman Correlation Coefficient, appropriate for non-parametric measures, was derived yielding r=.63, p=.001 for age and level. In order to further assess discreteness between levels the 13 operationalized behaviors were combined into the five construct levels which they tapped. Bonferroni *t* tests assessing mean age differences between levels were significant at .05. Mean ages (in months) for each level were 56,66,76,83,90 respectively.

Cluster Score

A Guttman scalogram analysis was performed to test the hypothesis that a difficulty order existed from one to five and that subjects passing Cluster 2 had also passed Cluster 1; subjects passing Cluster 3 had also passed Cluster 1 and 2, etc. The coefficient of reproducibility was .95 with a coefficient of scalability at .80.

Discussion

The data clearly substantiated the predicted ordinal scale of strategies. The youngest children attempted to balance the blocks by egocentrically placing them at random points on the fulcrum. If the block fell, which happened frequently, they declared that the block could not be balanced. The first corrections observed were towards the middle of the bottom plane of the blocks, even when these corrections were obviously in the wrong direction. This VCB theory was eventually transcended to include the whole block. Visual center theories, while successful for some of the blocks, when generalized to all the blocks became insufficient. Thus children eventually determined that area and weight were factors, made corrections towards these factors, and finally understood that weight must be equal on

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both sides of the balance point.

The Guttman analysis demonstrated that the lower level theories were necessary to the construction of the higher levels. The strategies, although related, were in no way sufficient to produce success on the clusters. In other words, children, in attempting to balance the blocks, frequently were willing to test out other variables than the one they believed to have an effect. For example, children with a VCB theory were willing to test out the middle of the whole block as a balance point. Those with a VC theory were willing to test out the effect of a shift towards the greater area; those with a belief that a bisection of the area was the correct point also tested out the effect of weight. But until they developed "physical necessity" (the understanding that each block was indeed possible), they did not struggle with the new variable enough to be successful with the cluster. To wit, while they were willing to test out variables which contradicted their theory, until they held fast to a new theory they did not struggle enough to be successful with the cluster which tested that theory.

Implications

Piaget's notion of reflexive abstraction suggests that learners need to reflect on the result of their actions in relation to the theory they hold about balance, i.e. contradictions and the resulting reflection bring the learner to produce higher level theories. Although this process seemed apparent in the protocols, there was insufficient data to corroborate such a premise. Thus the second part of this study was designed to test this assumption. It was hypothesized that egocentric children would benefit most from a reflection on the block's action, given their tendency to form assumptions about the role of their own action. According to Piaget,

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coordinating the action of the object with the self's action should result in the construction of a general physical principle. Thus a reflection, via video replay, on whether the block balanced or fell and to which side of the fulcrum it fell should be profitable. Theory oriented children, on the other hand were expected to profit more from reflection on the placements that were inconsistent with their theory. For example, a child who thinks the block will balance at point 3, but then sees via video replay that it actually balanced at point 2, might attempt to resolve this contradiction and thus construct a new theory.

Part II: Effect of Stop-action Video

Method

Subjects

One hundred and twelve of the subjects tested in part one of the study were classified as ego oriented or theory oriented. All children who successfully balanced at least one cluster of blocks were assigned to the Theory category, called theory because these children at least had a rule that worked for a subset of all blocks. All children who did not reach criterion on at least one cluster of blocks were assigned to the Ego category, called ego because these children attended more to their desire to have each block balance rather than to general principles about balance.

Materials

The materials used were the same as those in part one of the study.

Procedure

Subjects were randomly distributed into one of four different treatment conditions, given four training sessions, and then posttested. Sex was not controlled since a previous analysis (condition x age x sex) had shown no

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significant difference (Fosnot, 1983).

A basic factorial design of two orientation groups (ego vs. theory) and four training conditions was used. Children were pretested on the training tasks in session one, later given four training sessions, followed by a posttest session on the training task. Briefly, in Treatment Condition I, called the Predict Block condition, the child was asked to predict what the block on the fulcrum, stopped in action on the video replay, would do when the tape was reactivated. In Treatment Condition II, the Predict Placement condition, the child was asked to predict the placement from looking at the replay of the block stopped in mid-air just before placement on the fulcrum. In Treatment Condition III, called the Summarize Replay condition, the child saw the entire footage from the first grasp of the block to the end of the first clear release of the block and its subsequent balance or fall. The child in this condition was then asked to summarize what he/she had just seen in the tape segment. In Treatment Condition IV, called the Summarize No Video condition, the child was simply asked to summarize his/her most recent attempt to balance a block.

The design tested the null hypotheses that the means of the pre to posttest difference within each condition would be the same for the Ego group and that the means within each condition for the Theory group would be the same. No main effect for condition was expected. A significant interaction effect between orientation and condition was expected with the Ego group performing the best in the Predict Block condition and the Theory group performing the best in the Predict Placement condition.

General directions. The experimenter designated the green blocks and said, "I would like you to balance these blocks one at a time on here (points to the fulcrum). These are helper blocks which you may use to help you if

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you wish."

Blocks were then presented to the child one at a time by the experimenter. In sessions one and three the blocks were presented in a predetermined order. In sessions two and four that order was reversed.

Predict block condition. The experimenter presented each block, one at a time, with hands on each side of the block so that the bottom length of the block was clear. She said, "Try this one." At the presentation of blocks #2,4,5,6,10,11, and 14 the experimenter pressed the counter on the video recorder to zero. After the completion of the episode (child attempted to balance the block and it balanced or fell) with each of the aforementioned blocks, the experimenter rewound the tape to zero and said, "Let's look at you trying that block on television." The tape was then replayed until the point where the child placed the block on the fulcrum. The experimenter stopped that action by pushing the recorder switch to pause and asked, "What is the block going to do?" If the child did not respond, the experimenter probed with, "Will it balance or fall?" With a response of fall, the child was asked to show on the T.V. which direction the block would fall. The experimenter recorded each prediction on data sheets, then said to the child, "Let's see." The switch was then pushed to play and the remainder of the episode was replayed for the child to observe the correctness of the prediction. Blocks #1,3,6,7,9,12, and 13 were presented to the child for balancing but no video replay was given.

Predict placement condition. The same beginning directions were given as above. During the replay, stop-action occurred just before the child placed the block on the fulcrum. The child was then asked to predict the placement of the block. The experimenter said, "Show me where on the block you are going to place it." If the child did not understand the question,

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the experimenter said, "Here, or here, or here?" while moving her finger across the bottom of the block from point one to five. Predictions were again written down. The experimenter said, "Let's see." The remainder of the episode was then replayed.

Summarize replay condition. Directions were the same as in conditions I and II except that the tape was rewound to zero in the designated episodes and replayed for the child without stop-action. The experimenter then said, "Tell me what happened." Responses were written down.

No video condition. The child was presented each block to balance as in the other conditions. After the designated episodes, the child was simply asked, "Tell me what happened." Responses were written down by the experimenter.

Thus in all conditions subjects were questioned on seven episodes during a session. The length of each episode was the same across conditions since the replay began with the presentation of the block and ended when the child finished with the block.

Pre and posttest directions. The child was simply asked to try and balance each of the blocks, one at a time, on the fulcrum.

Measures

The dependent variable was a simple assessment (pre to post difference) of the number of blocks successfully balanced.

Results

Planned Comparisons

The mean difference scores between pre and posttests for each of the cells were calculated and planned comparison two-tailed Dunnett *d* tests were done to compare the performance of the experimental groups with the control groups. No significant difference was found between conditions for children

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who began with an ego orientation. For children who began with a theory strong enough to pass at least one cluster, this was not the case. As hypothesized, a significant difference (p=.05) was found between the group asked to predict the placement of the blocks and the group receiving no video feedback. As can be seen from Table 1, showing the means of the groups, theory children did best in condition II, although the difference was not statistically significant with groups other than the no video feedback group.

A closer look at which blocks were successfully balanced produced some further insights. When grouped by clusters, thereby eliminating luck as a possible factor, condition II produced more success than every other condition for the Theory group (p=.05) See Table 2.

Analysis of Variance

An analysis of variance with the regression approach for unequal N's was performed. Age was covaried. No main effect was found for the variables Orientation (F=.89, p=.35) or Condition (F=1.34, p=.27). A significant (F=2.6, p=.05) two-way interaction between Orientation and Treatment Condition was found. Post hoc Bonferroni t tests showed the interaction to be significant at .05 between the orientation groups in condition II. While this was the most successful training condition for the Theory group, it was the least successful for the Ego group.

Discussion

The data showed conclusively that for children who have already begun to think about a general means of balance, rather than what they themselves do in a specific instance, stop-action video improves performance if the stop-action orients the child to where he/she is about to place the block. This was seen in the Theory category of children in the Predict Placement condition. With this type of video feedback the children had to reflect on

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their reasons for each placement. Having to predict the placement just prior to the continuation of the feedback tape, combined with the feedback of the consequent success or failure, helped to bring the whole episode into an integrated system of means-end relations. Straight replay was not as poten a training condition, nor was reflection on the action of the block, suggesting that assumptions cannot be made about the content of the child's reflection. Repeated exposure is not necessarily constructive.

Ego children, while being younger than the Theory group, were also characteristically different in their approach to the training task. Response protocols indicated that these children were more often the children who made only brief adjustments with a block if it did not balance. They were more likely to attribute a failure to a "bad block" than to their own placement strategy. They were frequently children who explored the physical attributes of each block independent of how those attributes related to the balancing task.

Children in the Theory group understood, at least in part, that there was some rule that could be applied to several blocks, if not all blocks, that could be discovered if one thought clearly about several blocks at a time. These children would make spontaneous comments such as, "Hey, this one is not like the other one." This was most prevalent when two blocks looked alike but were weighted differently. Thus it is reasonable to conclude that children in the Theory group during training reflected more on the means to establish balance. The rules they constructed were the result of reflecting on means-end relations. The reflection facilitated by Condition I, Predict Block, is not as appropriate a match to the theory-oriented child's assimilatory schemes. The focus of this reflection is not means or theory oriented, but simply object/action oriented. The theory-oriented child is

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not thinking about "what" happens, but "why" it happens. Evidently reflection on the success and failure of the block, without relating the means by which that success/failure occurred, has no positive effects for problem solving in these situations.

Although the hypothesis about the advantage of the Predict Block condition for the ego-oriented children was not supported, there was a trend for this group to do better in Condition I than in the other conditions. It is possible that had training been longer than four sessions, a significant difference may have been found between conditions for the Ego children. Perhaps Condition I did facilitate a decentration from one's own actions to the action of the block more than the other conditions, but the step from an ego orientation to the first theory is a big one, requiring more time than going from a VC theory to an AC theory.

The reasons for the lack of success of Ego children in Condition II were obvious during the data collection. First, because they had no theory about a necessary placement, the question ascertaining placement made no sense to them and thus probably served as a distractor. Many Ego children during training were observed (in response to the placement question) tracing a vertical line on the monitor from the fulcrum to the point on the block directly above the fulcrum. In other words their responses were based on proximal causes rather than any theory about a "correct" placement. Other Ego children were just simply confused by the question and appeared to be guessing randomly.

Secondly, this condition for Ego children might have served as a negative reinforcer. For Ego children, the question, "Show me the spot on the block where you are going to put it" might have been interpreted with an emphasis on the "you". Thus the ensuing action of the block falling becomes

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a criticism of their placement. In contrast, Theory children might have emphasized the placement question in relation to a theory about balance, rather than themselves, thus the ensuing action of the block becomes feedback to confirm or disconfirm that theory.

Conclusions and Implications for Further Research

This study is evidence that, while reflection in general can be conducive to the development of higher understanding, when reflection is in relation to the learner's own question and focuses on contradictions it is more powerful. Such a conceptual understanding of reflection is in concert with the notions of learning as a constructed, self-regulated process. In the process of problem solving, the learner has expectations and hypotheses which he/she is testing, dependent on his/her stage of development. Reflection on the result of actions related to these hypotheses is more conducive to learning than simply reflecting on the whole episode. Assumptions cannot be made that because replay is provided the learner is necessarily focusing on the relevant aspects of the episode.

This study also serves as an illustration of how current technology can be used to study cognition. The use of video in part one of this study allowed for a naturalistic filming of the self-regulated behavior of the children as they attempted to balance the blocks. All adjustments, pauses, corrections, and apparent testing of variables could be captured on film and then analyzed later. These data then led to hypotheses about developmental differences in orientation to the task which were consequently tested in part two of the study.

While video technology was sufficient in this experiment in recording behavior, the analysis still had some subjectivity due to human raters making judgements while viewing the tapes. Although interater reliability was high,

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current computer technology could alleviate any subjectivity. If subjects attempted to solve a similar simulated physics task on a monitor, the computer could record all adjustments made and then determine the variables the subjects were apparently testing.

Computer programming also structures information into a theory testing paradigm. If a child is asked to write a program to simulate the physics of a task, he/she must construct a rule or formula to explain the phenomenom. When the program is run, if it does not work it must be "debugged" or analyzed for errors. This process is analogous to theory testing, a process demonstrated by the video study to be conducive to learning.

The following study has been designed as an extension of the video study using computer technology. Ninety-six boys and girls between the ages of 8 and 10 years will be asked to balance the blocks used in the video study. Two groups will be asked to do this task via a computer simulation (see Figure 2); a third group will serve as a control and will have direct experience with wooden blocks on a fulcrum. The computer groups will differ in that one group will have training in programming the blocks to balance while the other group will simply attempt to balance each block by directly moving the computer graphic. It is hypothesized that the group programming the blocks to balance, since programming requires the generating and testing of a theory, will progress further in an understanding of the physics involved than the groups having only graphic simulation or direct physical experience.

This study should allow educators to capitalize on the more unique features of computer technology in ways that ultimately give students more autonomy in evaluating their own theories about the scientific principles involved in physical knowledge. More importantly, it allows the researcher

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to be a more efficient, scientific theory tester of theory-testing behavior.

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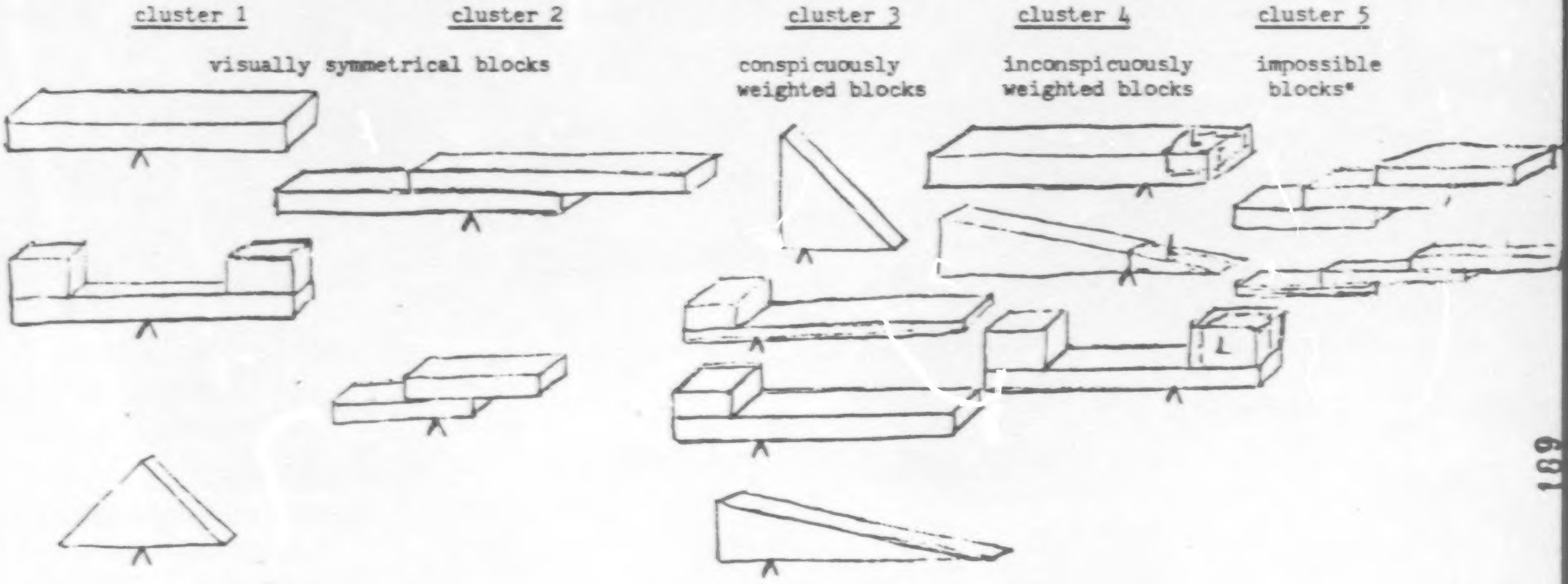
FIGURE 1

Balance task blocks. Blocks drawn to a 1:6 scale. Drawings arranged into 5 clusters.


cluster 1
cluster 2
cluster 3
cluster 4
cluster 5
visually symmetrical blocks
conspicuously weighted blocks
inconspicuously weighted blocks
impossible blocks*
L
L
L

^ designates balance point

L designates lead

* These blocks can be balanced with the use of helper blocks as counterweights

Helper Blocks:

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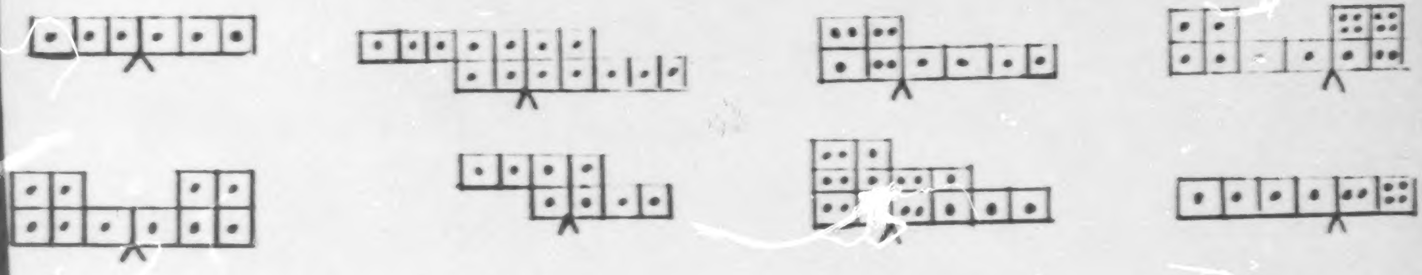
FIGURE 2

Computer Simulations of Blocks in Figure 1



cluster 1 cluster 2 cluster 3 cluster 4

∧ designates balance point (turtle placement)

TABLE 1

CHANGE IN NUMBER OF BLOCKS SUCCESSFULLY BALANCED BY TREATMENT CONDITION AND PRETEST ABILITY

	Treatment Condition			
Pretest Ability	Block I	Placement II	Replay II	No Video IV
Ego:				
$\bar{x}$ pre test score	1.8(1.5)*	2.5(2.1)	2.1(1.4)	2.2(1.3)
$\bar{x}$ post test score	3.3(2.4)	2.6(3.1)	2.9(3.1)	3.3(1.3)
mean change	1.5	.1	.82	1.17
Theory:				
$\bar{x}$ pre test score	6.7(3.4)	7.1(2.9)	6.4(2.7)	7.8(3.7)
$\bar{x}$ post test score	8.7(4.0)	10.8(3.3)	8.1(4.2)	8.5(4.6)
mean change	1.94	3.76	1.71	.71

*Standard deviations are in parentheses.

TABLE 2

CHANGE IN NUMBER OF CLUSTERS SUCCESSFULLY PASSED BY TREATMENT CONDITION AND PRETEST ABILITY

	Treatment Condition			
Pretest Ability	Block I	Placement II	Replay III	No Video IV
Ego:				
$\bar{x}$ pre test score	0(0)*	0(0)	0(0)	0(0)
$\bar{x}$ post test score	.6(.8)	.4(1)	.5(1)	.5(.9)
mean change	.6	.4	.5	.5
Theory:				
$\bar{x}$ pre test score	2.01(1.1)	1.9(1)	1.7(1)	2.3(1.2)
$\bar{x}$ post test score	2.6(1.7)	3.5(1.3)	2.2(1.6)	2.7(1.8)
mean change	.6	1.6	.5	.4

*standard deviations are in parentheses.

DEFINING ATTRIBUTES OF ANALYTIC ABILITY AS A PREREQUISITE FOR SELECTION OF INSTRUCTIONAL STRATEGIES

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INTRODUCTION

This study supports the view that the degree of differentiation exhibited by field-independent and field-dependent learners will affect analytic strategies used to process visual information. The purpose of this study was to explore the defining attributes of analytic ability as they relate to theoretical cognitive styles originally described by both Witkin, Dyk, Faterson, Goodenough and Karp, (1962) and Kagan, Moss & Sigel, (1963).

RATIONALE

Technical and vocational training relies heavily on the use of visuals. The instructional designer is faced with a recurrent question of how to design visuals which facilitate effective, efficient processing of information. Often technical line - drawings are required, which demand analytic skills in perceptual and cognitive restructuring (Cf. Witkin, Moore, Goodenough & Assoc., 1977).

When learners are to perform a concept attainment task, they are required to use a stylistic capacity to break down the line - drawing into its component parts (in an analytical manner) as a prerequisite for processing the concept information (Witkin, Moore, Goodenough & Cox, 1977). Field-independent learners have demonstrated more effective strategies in tasks which demand analytic skills in perceptual and cognitive restructuring, whereas the field-dependent learner:

> ...is likely to have difficulty with that class of problems, where the solution depends on taking some critical element out of the context in which it is presented and restructuring the problem material so that the item is now used in a different context. (Witkin and Goodenough, 1977, p.8).

Kagan, Moss and Sigel (1963) have also identified a strategy of information processing which they described in terms of a tendency to analyse stimuli into differentiated parts, as opposed to a non-differentiated, global acceptance of the entire stimulus.

The common use of the terms analytic and non-analytic by both Witkin (Witkin, Dyk, Faterson, Goodenough, and Karp, 1962) and Kagan (Kagan, Moss and Sigel, 1963) has tempted several researchers to suggest that the field-dependence-independence notion of Witkin, and the dimension studies by Kagan, may relate to the same ability (Doyle 1965, Messick and Fritzky 1963, Stanes and Gordon 1973, Wachtel 1968). Cronback and Snow (1977) have noted that the constructs of Kagan and Witkin appear to be conceptually related.

Accurate codification of the analytic term may be crucial in some aspects of cognitive style research. According to Wallach (1962), the essential task for those conducting research on cognitive style is to ascertain each style's defining attributes. Knowledge of these stylistic attributes will guide the investigator in a search for other "manifestations of the 'same' style" (Wallach, 1962, p. 199). Furthermore, increased knowledge of relevant stylistic attributes and learner processing capacities may aid in the specification of effective instructional design strategies for concept attainment tasks. Ausburn and Ausburn (1978) have pointed out that knowledge of stylistic attributes is necessary a prerequisite for selection of instructional design strategies which consider the processing demands of the learning task. The need for consideration of processing demands has been highlighted by research which has shown that individuals are likely to favor and do better in tasks in which they are suited by their cognitive style (Cronbach and Snow 1977, Witkin and Goodenough, 1977).

The rationale for this study is based on the following assumptions:

- the better a visual is perceived, the better it can be encoded, remember and utilized.
- a learner's ability to implement effective processing strategies is influenced by task demands, media attributes and learner aptitude.
- learning will be most effective when task demands and media attributes either precisely complement the processing aptitude of the learner, or adapt to the learner's aptitude.
- increased knowledge of the stylistic attributes of analytic ability may aid in the design of instructional visual for concept attainment tasks.

DISCUSSION

This study defined the cognitive style, field-dependence-independence as reflecting an analytic ability termed fluid intelligence (cf. Cattel, 1971; Cronbach and Snow, 1977; Snow and Peterson, 1980). According to Horn (1976), fluid intelligence is measured in tests of reasoning which employ figural and non-word symbols: that is non-verbal intelligence tests. In theory, field-dependence-independence may be considered to be one expression of a more general individual difference dimension, defined at one extreme by a global mode of processing and at the other extreme by a more differentiated, analytical manner of processing (Witkin, Dyk, Faterson, Goodenough and Karp, 1962, 1974). In people with a relatively analytic cognitive style, experiences can be analysed, and if necessary, restructured through the use of internal referents. By contrast, in people with a relatively global cognitive style, experiences are governed by external referents and dominant organization of the field (Witkin and Goodenough, 1977). A central hypothesis in field-dependence-independence theory is that individual differences in expressions of articulated or differentiated functioning in one area are related to expressions in other areas. A considerable body of evidence supports this hypothesis (Witkin, Goodenough and Oltman, 1977). Thus, the more differentiated mode of the field-independent person is evidenced in a more active approach towards analysis and structuring in both perceptual and intellectual activities. Global cognitive functioning, on the other hand, is represented by a more passive manner of dealing with the field, accepting it as presented with limited analytical and structuring abilities in both perceptual and intellectual activities (Witkin and Goodenough, 1977).

In the typical concept-attainment problem, stimuli composed of a number of attributes are used. It has been suggested that problems of this sort may require perceptual and intellectual analysis of the stimulus complex into its relevant attribute components, a requirement that is more easily attained by field-independent learners (Dickstein, 1968). In this view, field-dependent subjects are dominated by the salient (that is, most noticeable) attributes of the stimulus, which may achieve a figural quality against the ground provided by other aspects of the stimulus configurations. When directed to construct hypotheses about the concept definition, these learners respond to the salient, external referents rather than sampling broadly from the set of available stimulus attributes, as field-independent individuals are likely to do (Kirschenbaum, 1968; Shapson, 1973).

This emphasis on strategies used by learners supports Cronbach and Snow's contention (1977) that the study of cognitive style should involve individual differences in process rather than content variables; that is, investigators should be more interested in individual differences in modes of processing information. Research has shown that individuals are likely to favor and do better in tasks in which they are suited by their cognitive style (Witkin and Goodenough, 1977). Field-independent people have demonstrated more effective strategies in concept learning tasks which demand analytic skills in perceptual and cognitive restructuring (Witkin & Goodenough, 1977).

Kagan, Moss and Sigel (1963) have also identified a strategy of information processing which they describe in terms of a tendency to analyse stimuli into differentiated parts, as opposed to a nondifferentiated, global acceptance of the entire stimulus. Kagan et al. noted the similarity of this dimension to the field-dependence-independence dimension studied by Witkin, Dyk, Faterson, Goodenough and Karp (1962). In reply, Witkin (1963) cautioned that despite many apparent similarities, there was still considerable question as to how closely the two concepts were related.

Attempts to investigate empirically the relation between the dimensions studied by Kagan and by Witkin were made by Messick and Fritzky (1963) and Wachtel (1968). Wachtel felt that if a relationship did exist between field-dependence-independence (Witkin's concept) and analytic attitude (Kagan's concept), it may be highlighted if extreme groups were studied and compared. Consequently, subjects for his study were preselected on the basis of their Embedded Figures Test performance, and then these extreme groups of field-dependents and field-independents were compared on a a measure of analytic attitude. He utilized a visual analytic attitude task developed for use with adults by Messick & Fritzky (1963). The task was modelled on one used by Kagan in his research with children. This test of analytic attitude was based on the following percept:

> An analytic child presumably differentiates complex arrays to a greater degree than a non-analytic child. That is, he applies labels to the whole stimulus as well as to the parts. He reacts to a different immediate environment, if the environment is defined, in part, as that sector of the stimulus field that is labelled. One method of testing this hypothesis is to require the individual to learn a response to a complex stimulus and to assess subsequently the degree to which the response is transferred to discrete parts of the original stimulus. (Kagan, Moss and Sigel, 1963, p.94)

Kagan's aim in developing this test was to assess its relationship to the conceptual styles or strategies used by individuals in concept formation tasks. He illustrated that children who scored as being "analytic" on the visual, analytic attitude test also tended to use a more active, analytical strategy in forming conceptual grouping, whereas children who scored towards the "global" end of the dimension on the analytic attitude test tended to use a more passive conceptual strategy, based on a global acceptance of the entire stimulus. Wachtel (1968) also related the visual Test of Analytic Attitude to a conceptual style task. However, a more significant outcome of his study was to point out a very strong relationship between *Embedded Figures Test* performance and scores on the *Test of Analytic Attitude*. Results should not be interpreted to mean that the two approaches measured exactly the same dimension.

Both Kagan *et al*. (1963) and Witkin (1963) stressed the multidimensional nature of their view of strategies used by individuals. Messick and Fritzky (1963) reflected that conceptually Kagan's test measured a tendency to experience items as discrete components of a visual field. Witkin, Kyk, Faterson, Goodenough and Karp (1962) have described field-dependence-independence not only as a tendency to experience items as discrete from their backgrounds, but also as ability to overcome the influence of an embedding context. The importance of the relationship of the two approaches appears to lie in their unique interaction in tasks that require analytic skills, since the overcoming of embedding influences would seem to be facilitated by a tendency to experience items as separate from their contexts and *vice versa* (Messick and Fritzky, 1963).

Accurate codification of the analytic term may be crucial in some aspects of cognitive style research. According to Wallach (1962), the essential task for those conducting research on cognitive style is to ascertain each style's defining attributes. Knowledge of these stylistic attributes will guide the investigator in a search for other "manifestations of this 'same' style" (Wallach, 1962, p. 199).

Research on Witkin's articulated-global dimension has raised the possibility that "analytic" or "articulated" functioning in his terms may consist of two separate but related factors: (a) reliance on internal (bodily) or external (visual) referents, as well as (b) greater or lesser competence in cognitive restructuring (Witkin and Goodenough, 1977). Furthermore, Witkin, Goodenough and Oltman (1977) have defined field-dependence-independence as "extent of autonomous functioning," (p. 24) with field-independent people demonstrating more autonomous, differentiated functioning through the use of internal referents, and field-dependent individuals tending to prefer the use of external, visual referents in their global, less differentiated and less autonomous approach. Traditionally, field-dependence-independence has been associated with tests of embeddedness, for example, Group Embedded Figures Test (Witkin, Oltman, Raskin and Karp, 1971). In Witkin's recent differentiation model, embeddedness tests were specified as examples of cognitive restructuring tasks (Witkin, Goodenough and Oltman, 1977). In summary, Witkin's current view of the analytic-global dimension is defined by two factors relating to disembedding and to autonomy which are evidenced in that reflect a state behaviors of relatively greater or less differentiation (Witkin, Goodenough and Oltman, 1977). By implication, performance on tasks which require analytic structuring, for example, concept acquisition tasks and Kagan's visual analysis task (that is, Test of Analytic Attitude), may also reflect the individual's state of differentiation. As field-independent cognitive style has been associated with more differentiated functioning, high performance on analytic structuring tasks may be related to ability to structure experience into discrete parts, as well as capacity to disembed relevant details and restructure information as required. As field-dependent cognitive style has been associated with less differentiated functioning, low performance performance on analytic structuring tasks may be related to lack of ability to structure experience into discrete parts as well as less capacity to dissembled relevant details and restructure information as required.

METHOD:

For convenience in data collection, it was decided to use the Group Embedded Figures Test (Witkin, Oltman, Raskin and Karp, 1971), as a measure of field-dependent-independent aptitude. Only students designated as extremely field-dependent or extremely field-independent by their Group Embedded Figures Test (GEFT) score were included in the study. Scores were analysed with the upper and lower 26% of scores determined to represent the extremes of field-independent and field-dependent subjects respectively. This technique followed statistical procedures of Kelly (1939), Greco and McClung (1979) and McClung (1975). Cronbach and Snow (1977) have recommended the use of high and low extreme groups by pointing out that such a design is appreciably more powerful than a study with the same sample population distributed over the full aptitude range.

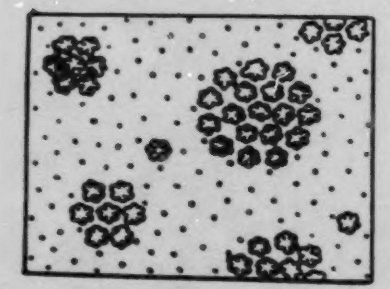
This study sought to compare scores on the GEFT with scores on an adaptation of Kagan's visual analysis task, that is, the Test of Analytic Attitude (Messick, 1962). Messick and Fritzky (1963) and Wachtel (1968) have utilized this adaptation for adults of the visual analysis task developed by Kagan, Moss and Sigel (1963). The adult version of the task first requires each subject to learn nonsense syllable labels for a series of complex, geometric designs. Next, the subjects are asked to supply the appropriate design label for a single aspect (part) of the preveiously-learned design. For example, the subject might be shown only the background pattern from the original design or just isolated elements from the original design. In other words, the Test of Analytic Attitude measures each subject's capacity to identify part aspects, termed design variations, from previously-learned designs.

Dependent variables consisted of seven different scores on the analytic attitude task. The first, termed ORIG, refers to the measure of the subjects' ability to memorize the six original, complete designs together with their nonsense syllable labels. The ORIG score refers to the number of original designs correctly identified before presentation of the design variations. The remaining six dependent variables refer to the six types of variations of the original designs that were utilized in the test of analytic attitude. An example of an original design and its six variations are illustrated in Figure 1.

These variations are of the following types:

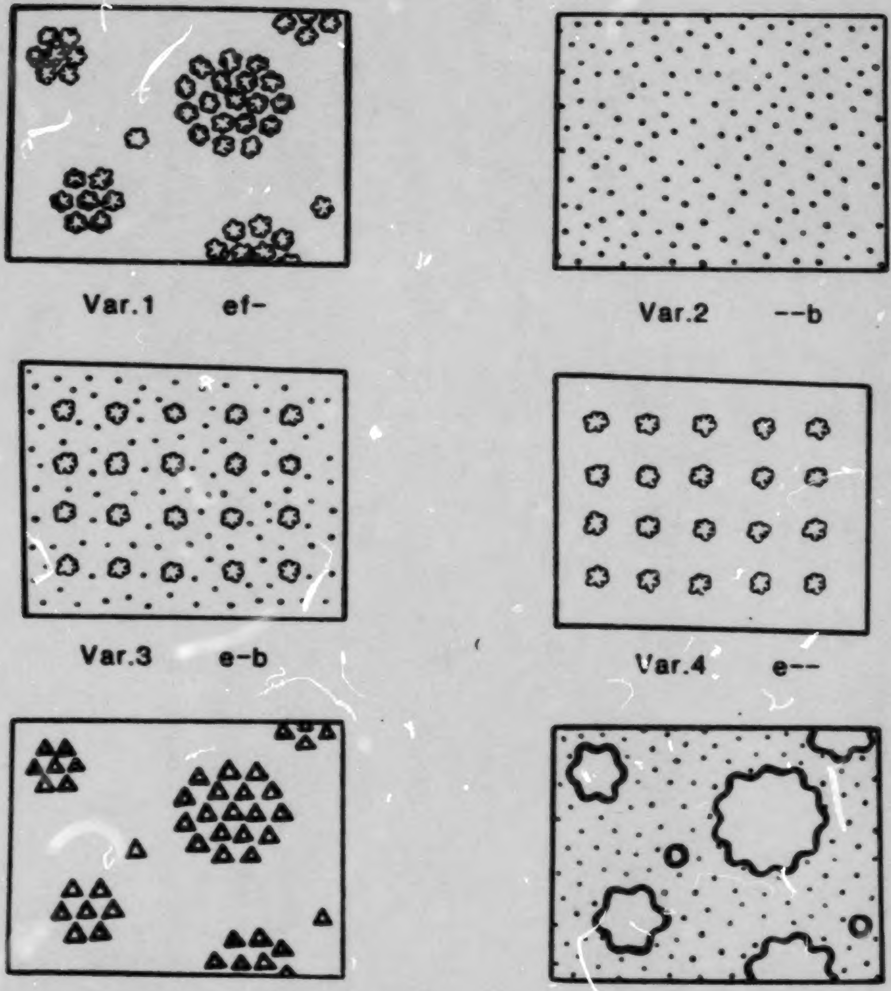
Variation 1	The original figure composed of the original elements, with no background (denoted ef-, for element, figural form, no background).
Variation 2	Original background only (--b).
Variation 3	The original element uniformly spaced against the original background, with no figural form (e-b).
Variation 4	The original element uniformly spaced with no background and no figural form (e--).
Variation 5	The original figural form represented by means of a new and different element, with no background (-f-).
Variation 6	The original figure indicated by enclosing lines against the original background, with no element (-fb-).

This test of analytic attitude was composed of two sections. The first section was called "Memory for Designs" (Orig.) by Messick and Fritzky (1963). In the present study, this section was termed 'ORIG'. This first test section required each subject to learn six, original designs so that they could be recognized by name. Each subject was given a page containing six complex, geometric designs, under each of which was printed a nonsense-syllable label. Each original design consisted of a figural form, made up of discrete elements, and a background pattern. After the defined time limit, this page was replaced by a second page which presented the six designs again, but in a different order and without their labels. Subjects were asked to supply the appropriate nonsense syllable label for each design.



VIS

The Original Design



Var.1 ef-

Var.2 --b

Var.3 e-b

Var.4 e--

Var.5 -f-

Var.6 -fb

Figure 1 : Examples of an original design "vis" and its six variations. (Adapted from a Measure of Analytic Attitude devised by S. Messick, 1962.)

After a short period, this test page was replaced by a second section of the task. Messick and Fritzky called this second section "Identifying Variations". The second section consisted of a booklet containing thirty-six designs; that is, six variations of each of the original six complex designs. These variations consisted of either the background pattern, the original figural form or shape without the elements, the original elements alone, or some combination thereof. The subjects were required to supply the appropriate label for each variation based on their learning of the six original complex designs. It should be noted that the six nonsense labels were boldly printed across the bottom of all pages in both Section I and II of this task. Thus, subjects were not require to hold the actual, verbal labels in memory. A sample page from the test booklet's shown in Figure 2.

In summary, this study sought to determine whether a relationship existed between the scores for the six design variations and extreme scores on the field-dependence-independence dimension as measured by the Group Embedded Figures Test (Witkin, Oltman, Raskin and Karp, 1971). Three types of scores were compared with field-dependence-independence scores:

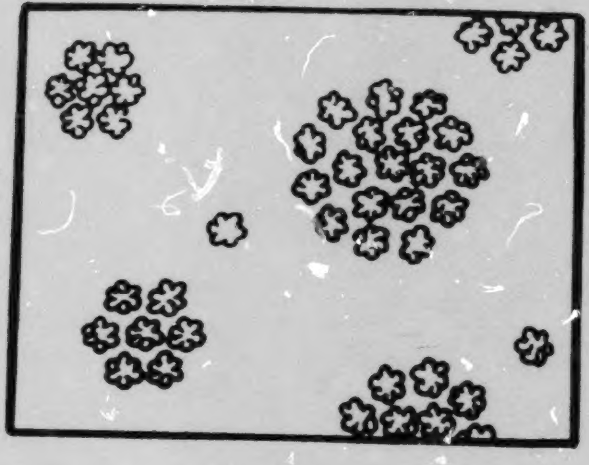
1. the six "variations" scores
2. a total score for the six variation scores combined
3. a memory score (ORIG) for the original six designs and their nonsense syllable labels.

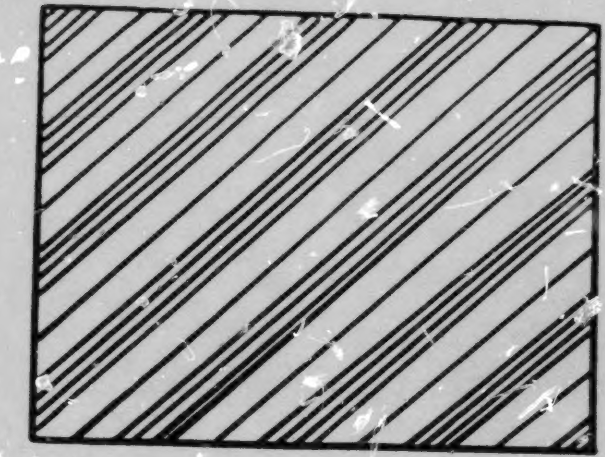
Of a sample of 492 males aged from 16-21 years, 113 were determined to score within the extreme field-dependent range, and 106 were designated as having extreme field-independent cognitive style.

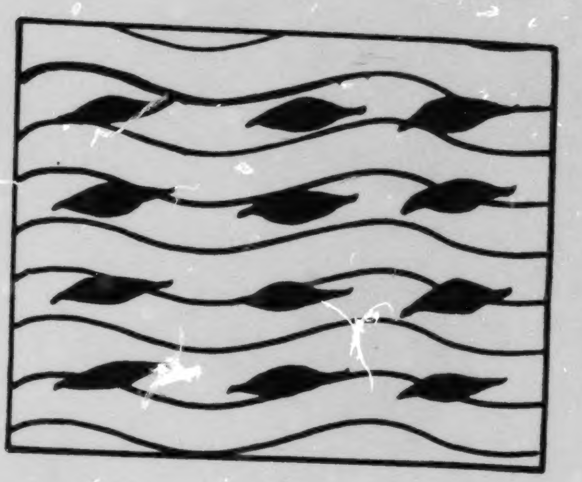
An Overview of Data Analysis

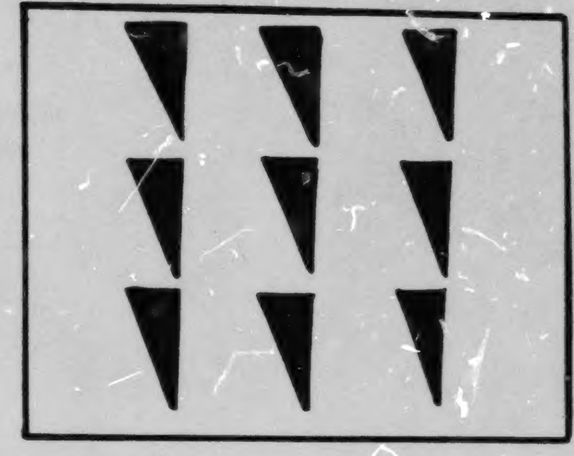
A one-way analysis of covariance was used to analyse data. The score for the number of correctly identified original designs; that is, the original memory score (ORIG), was utilized as the covariate. The ORIG variable was inserted into the design to control and remove extraneous variation from the remaining seven dependent variables; that is, the six individual variations scores plus the composite score. Field-dependent-independent aptitude was the categorical independent variable of primary interest to the analysis. To determine the effect of this factor on test scores, regression procedures were used to remove variation in each dependent variable due to the covariate (ORIG). Conventional analysis of variance then was performed on the "corrected" scores. Where analysis revealed significant differences, visual inspection of the two relevant aptitude means indicated the nature of the difference.

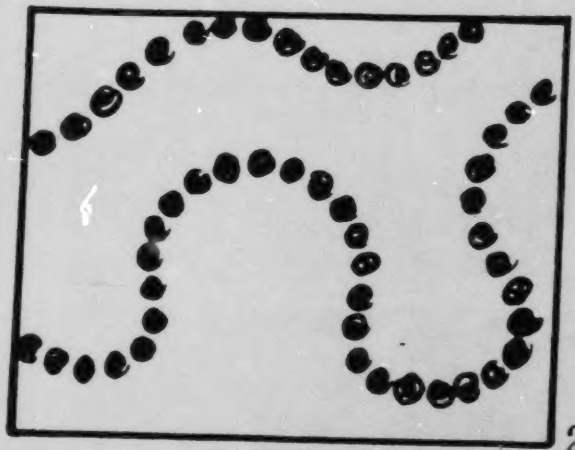
Figure 2: Sample Test Page

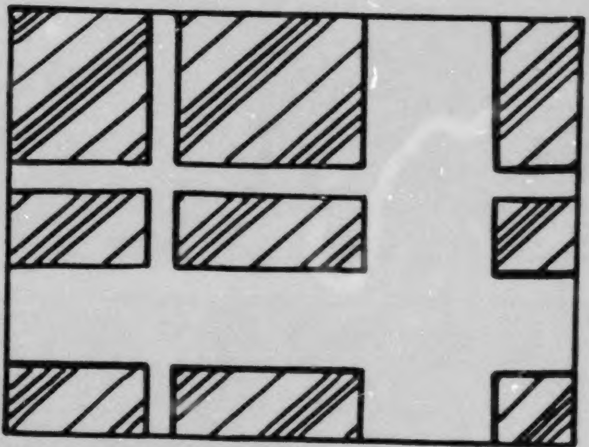












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Supplementary analyses were conducted to aid in the interpretation of results. These analyses included:

1. Measures of the sensitivity of the design. Determinations of appropriate sample size and power were conducted using procedures given by Cohen (1969) and Keppel (1973).

2. Estimates of treatment magnitude (Omega squared). These estimates were constructed using procedures given by Keppel (1973, 1982) and Kirk (1968).

3. Tests for homogeneity of variance for all measures. These tests were conducted using procedures given by Kirk (1968) and Winer (1971).

4. Estimates of reliability (r_{tt}). The Kuder-Richardson (K-R) formula 21 was used to estimate the reliability of measures used. Formula and procedures were given by Guilford, (1973, pp. 417-418). It should be noted that this Kuder-Richardson formula tends to *underestimate* the reliability of a test (Guilford, 1973).

RESULTS AND INTERPRETATION OF FINDINGS

Analysis of the Original Memory Score (ORIG)

The original memory test was conducted to ensure that both the field-dependent aptitude group and the field-independent aptitude group were equivalent in their ability to memorize the six, original, complete designs together with their nonsense syllable labels. Comparison of the two group means revealed that there was a significant difference between the ORIG scores of the two aptitude groups, t (149) = 3.82, $p < .001$. It is important to note the the t value was based on a separate variance estimate because of the violation of the homogeneity assumption.

Because of the statistically different difference between field-dependent subjects and field-independent subjects on the ORIG test, it was determined that subsequent analyses of all test measures would utilize analysis of covariance with the ORIG scores held constant as the covariate.

Analysis of the Composite Score

HO_1: There is no difference in performance of field-dependent or field-independent subjects on a test of analytic attitude.

The null hypothesis was rejected for the total performance measure (the composite score). That is, field-independent subjects' total performance was significantly greater than field-dependent subjects' total scores on a test of analytic attitude. Estimates of treatment magnitude (omega squared) revealed that the main effect for aptitude accounted for 18% of the total variance. According to interpretative conventions proposed by Keppel (1982) and Cohen (1977), this estimate may be considered to represent a large effect. Table 1 shows a summary for the analysis of covariance for the composite score.

Analysis of Variations Scores 1-6

HO_2: There is no significant difference in performance of field-dependent or field-independent subjects for any of the design variations on a test of analytic attitude.

The null hypothesis was rejected for each of the six variation scores. That is, field-independent subjects' scores were significantly higher than field-dependent subjects' scores on each of the design variations in a test of analytic attitude (see Tables 2-7). Estimates of treatment magnitude (omega squared) revealed that the main effects for aptitude accounted for: (a) 6.2% of total variance on the variation 1 score; (b) 16.2% of total variance of the variation 2 score. (c) 9% of total variance on the variation 3 score; (d) 7% of total variance on the variation 4 score; (e) 20% of total variance on the variation 5 score; (f) 19% of the total variance on the variation 6 score. These tests of treatment magnitude for variation 2, 5 and 6, suggest that aptitude differences accounted for large proportions of the total variance for each of these three measures.

Post hoc analyses of power revealed that the size of the effects for aptitude plus the large sample sizes and small error term combined to result in extremely high power estimates (>.95) for all of the variations scores and the composite score. These results increased the confidence in: (a) the sensitivity of the experiment to detect real differences, and (b) the correctness of all decisions to reject null hypotheses.

The reliability coefficients for variations r_{tt} = .61 (variation 1), r_{tt} .70 (variation 2),r_{tt} = .67 (variation 3), r_{tt} .64 (variation 4), r_{tt} = .64 (variation 5), r_{tt} .65 (variation 6), and r_{tt} = .92 (composite score).

Cronbach and Snow (1977) have recommended the inclusion of descriptive statistics in the analysis of data relating to subject aptitude. Consequently, aptitude group means and standard deviations have been presented in Table 8.

Results of Hartley's Test of Homogeneity of Variance for all posttest scores are reported in Table 9.

Discussion and Interpretation of Results

In summary, performance on a test of embeddedness and cognitive restructuring (GEFT) was found to be highly related to performance on a Test of Analytic Attitude. The relationship between these measures can be interpreted to support a view of common, underlying analytic/non-analytic tendencies (cf. Messick and Fritzky, 1963; Wachtel, 1968). Findings should not be interpreted to mean that non-analytic/analytic attitude and field-dependent/field-independent cognitive style are identical constructs. The redefinition of field-dependence-independence within differentiation theory has extended this dimension from a narrow perceptional view to a broader multidimensional view of individual functioning.

Results confirm Wachtel's finding (1968) of a general superiority for field-independent subjects in identifying element, figural form and background aspects. Both the results from the present study and the results from Wachtel, are somewhat inconsistent with those of Messick and Fritzky (1963), who found that the field-dependence-independence dimension related only to the element variations of the original designs. Wachtel (1968) found almost all variation types to be significant. He noted that he had used a powerful experimental design. Messick and Fritzky did not use extreme groups. Instead, they utilized an unselected ample of subjects representing a wide range of Embedded Figures Test (EFT) scores. The present study supports Wachtel's assertion that a positive relationship between all scores for design variations on a test of analytic ability and EFT performance will be revealed, if the more powerful extreme groups design is used.

Study of differentiation theory has extended this dimension from a narrow perceptional view to a broader multidimensional view of individual functioning. It is suggested that the observed relationship between performance on the Group Embedded Figures Test and a Test of Analytic Attitude illustrates differentiated/analytic tendencies which can be related to aptitude processes strategies and resultant performance in a concept attainment task. The following interpretation of findings is offered:

The attainment of concepts from line-drawings is favored by more analytic, differentiated modes of processing. The successful application of this mode allows more differentiated field-independent individuals to avoid domination by the overall organization of the stimulus field, the embedding context. As a consequence these learners are more able to isolate analytically, the relevant concept attributes. This serves as a necessary prerequisite for competent execution of processes through which the concept attributes are defined, combined and associated to form each concept. For field-independent learners, these processes have been associated with wholist, hypothesis-testing strategies. The isolation of all relevant details is imperative in order to form a comprehensive first hypothesis which will subsequently be tested, modified and revised through this hypothesis-testing strategy. Extremely field-dependent individuals are less capable of differentiated functioning. They appear to experience difficulty in overcoming the embedding context and thus lack the restructuring ability necessary to isolate relevant details. Their difficulty is particularly apparent when processing time is limited by externally-paced presentations.

Thus, the difficulty evidenced in isolating details (part aspects) of the visual may inhibit competent execution of processes through which the concept attributes may be defined, combined and associated to form each concept. These results provide the following instructional design challenge:

> Given an aptitude variable and some analyses of the processes it reflects, one then asks: What instructional techniques would make this competence especially relevant to learning? What would a treatment have to provide to make learning easy for the low-aptitude S? (Cronbach and Snow, 1977, p. 172)

Investigations to answer this challenge are needed to provide real-world significance for the practitioner who uses line-drawings to teach concepts and wishes to consider cognitive style attributes. Such a blend of research, theory and practice is imperative for the design of aptitude sensitive instruction.

Table 1

Analysis of Covariance for Scores on the Composite Measure (Study II)

Source of Variance	SS	df	MS	F
(ORIG) - Covariate	2697.265	1	2697.265	55.121
Aptitude	2974.712	1	2974.712	66.791*
Explained	5671.976	2	2835.988	57.956
Residual	10569.567	216	48.933	-
TOTAL	16241.543	218	74.502	-

* $p < .0001$

Table 2

Analysis of Covariance for Scores on Variation I
(Study II)

Source of Variance	SS	df	MS	F
(ORIG) - Covariate	85.336	1	85.336	52.151
Aptitude	30.995	1	30.995	18.942*
Explained	116.331	2	58.166	35.546
Residual	353.449	216	1.636	-
TOTAL	469.781	218	2.155	-

* $p < .001$

Table 3

Analysis of Covariance for Scores on Variation 2
(Study II)

Source of Variance	SS	df	MS	*F*
(Orig) - Covariate	90.346	1	90.346	35.592
Aptitude	126.873	1	126.873	49.982*
Explained	217.219	2	108.610	42.787
Residual	548.288	216	2.538	-
TOTAL	765.507	218	3.511	-

* *p*< .0001

Table 4

Analysis of Covariance for Scores on Variation 3
(Study II)

Source of Variance	SS	df	MS	F
(ORIG) - Covariate	89.107	1	89.107	45.852
Aptitude	53.860	1	53.860	27.714*
Explained	142.967	2	71.484	32.783
Residual	419.772	216	1.943	-
TOTAL	562.740	218	2.581	-

* $p < .001$

Table 5

Analysis of Covariance for Scores on Variation 4
(Study II)

Source of Variance	SS	df	MS	F
(ORIG) - Covariate	105.481	1	105.481	55.182
Aptitude	43.961	1	43.961	22.998*
Explained	149.442	2	74.721	39.090
Residual	412.887	216	1.912	-
TOTAL	562.329	218	2.579	-

* $p < .001$

Table 6

Analysis of Covariance for Scores on Variation 5 (Study II)

Source of Variance	SS	df	MS	F
(ORIG) - Covariate	33.190	1	33.190	13.545
Aptitude	140.034	1	140.034	57.146**
Explained	173.224	2	86.612	35.346
Residual	529.296	216	2.450	-
TOTAL	702.521	218	3.223	-

* $p < .0001$

Table 7

Analysis of Covariance for Scores on Variation 6
(Study II)

Source of Variance	SS	df	MS	*F*
(ORIG) - Covariate	67.072	1	67.072	30.258
Aptitude	129.381	1	129.381	58.367*
Explained	196.453	2	98.227	44.312
Residual	478.807	216	2.217	-
TOTAL	675.260	218	3.098	-

* $p < .0001$

TABLE 8

Group Means and Standard Deviations for Field-Dependent and Field-Independent Aptitude

		APTITUDE					ROW	
Test Measure	Field-Dependent					Field-Independent		
	x̄	(SD)	n	x̄	(SD)	n	x̄	n
a Original Score	5.72	(0.62)	113	5.95	(0.21)	106	5.83	219
1. Variation 1	4.12	(1.61)	113	5.15	(1.10)	106	4.62	219
2. Variation 2	2.56	(1.68)	113	4.35	(1.60)	106	3.42	219
3. Variation 3	3.88	(1.73)	113	5.15	(1.20)	106	4.49	219
4. Variation 4	3.74	(1.71)	113	4.95	(1.23)	106	4.33	219
5. Variation 5	2.24	(1.56)	113	3.98	(1.62)	106	3.08	219
6. Variation 6	3.83	(1.62)	113	4.59	(1.41)	106	3.68	219
Composite Score	19.33	(8.04)	113	28.20	(6.79)	106	23.62	219

TABLE 9

Results of Hartley's Test of Homogeneity of Variance for all Posttest Scores

Test Measure	Largest Variance	Smallest Variance	df	F_{max}
a. Original (ORIG) Score	0.3823	0.0454	2,112	8.45*
1. Variation 1	2.5986	1.2012	2,112	2.16*
2. Variation 2	2.8325	2.5504	2,112	1.11*
3. Variation 3	2.9929	1.4400	2,112	2.08*
4. Variation 4	2.9207	1.5228	2,112	1.92*
5. Variation 5	2.6374	2.4196	2,112	1.09*
6. Variation 6	2.6244	1.9994	2,112	1.31*
Composite Score	64.6416	46.1041	2,112	1.40*

* $p < .05$

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RESEARCH AND THEORY INTO INSTRUCTIONAL PRACTICE: A REALISTIC CHALLENGE OR AN IMPOSSIBLE DREAM

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To many in our profession, linking research theory with practical implementation, may appear to be an impossible dream. Practitioners are the potential "knowledge users" of research findings and theory who search for information to assist practical implementation in an instructional setting. A "knowledge user" may be likely to assert that "the only true test of value for instructional theory lies in the extent, if any, to which it improves [the end result of] instruction and student learning (Snelbecker, 1983, p. 441). Conversely, those theorists and researchers who are "knowledge producers," may tend to view research findings, principles and theories as end results" (Snelbecker, 1983, p. 440). Because of these difficult perspectives, both extremes may be skeptical of the worth or utility of linking research and practice, as suggested by Passmore's perception that "there is nothing so practical as good research" (1984, p. 24). Many "knowledge producers" may be little concerned with practical implications because of their commitment to obtain and interpret empirical findings relevant to the research. Is there as Morell suggests, a "'culture gap' between those who 'do' and those who 'find out'?" (1984, p. 7). Jackson and Kieslar (1977) have observed that most practitioners prefer to rely on experience and intuition, rather than to turn to researchers for advice. At best, there could be greater interplay between knowledge users and knowledge producers (Shoemaker, 1984).

> If disciplined inquiry using the research process should be used to find a solution to instructional problems, then it becomes necessary to reduce the separation between research and practice. "This alienation should not exist in an active, creative profession" (Passmore, 1984, p. 26).

Theorists, researchers and practitioners should consider their professional charter to be that of a problem-solver (cf. Plomp and Verhagen, 1983). As problem-solvers, we need to respond to the challenge of integrating research findings within models which may be used to meet the needs of practitioners. As knowledge producers, we need to create models which establish a dynamic balance between research, theory and practice. This problem-solving challenge is based on the premise that it is not an impossible dream for a professional in our field to answer the following questions:

1. Given a defined training/instructional need or problem, can we recommend appropriate solutions with a high degree of confidence?

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2. Can we develop models derived from research and theory to help us define alternative solutions which consider:

   - reliability,
   - validity,
   - generalizability of research findings?

3. Can we rely on the technology of our field to provide these solutions?

   Let's look at these three questions and their implications in more depth.

1. Given a defined training/instructional need or problem, can we recommend appropriate solutions with a high degree of confidence?

   Before answering this question it is important to review:

   - the difference between prescriptive and descriptive theories and the implications of this difference on finding solutions.

   - causes for difficulty in translating principles from learning theory and instructional theory into instructional design and development.

The goal of a prescriptive theory is to prescribe optimal methods of instruction (Glaser, 1976; Reigeluth, 1983; Snelbecker, 1974). This goal may be contrasted with the goal-free nature of a descriptive theory which aims to describe the processes of learning/instruction. Reigeluth (1983) has summarized the distinction between descriptive and prescriptive theories (see Figure 1). His model suggests that descriptive theories establish condition and method variables as independent variables which may interact to produce effects, i.e., instructional outcomes which are dependent variables. Descriptive instructional theory places emphasis on investigating instructional variables, i.e., how information is presented to the student. In contrast, prescriptive theories establish the desired outcomes and conditions as independent variables which may interact and be used to prescribe appropriate instructional methods. That is, descriptive theories describe outcomes and effects, whereas prescriptive theories are concerned with prescribing a model which will be optimal in reaching desired outcomes under different conditions.

The act of recommending appropriate instructional solutions implies an ability to prescribe a program of instruction. Confusion emerges when there is an expectation that a prescriptive theory and an instructional program can be derived from a descriptive theory (Landa, 1983). As Landa explained, a prescriptive theory and program of instruction cannot be derived directly from a descriptive theory.

> Suppose, for example, that a descriptive learning theory says that if a person better understands a text, then he or she remembers it more easily.

> (Or: In order to more easily memorize the text, it is important to better understand it.) From this seems to follow a prescriptive instructional rule: In order for a learner to better memorize the text, it is necessary (or sufficient) to teach him or her how to understand it (or bring him or her to understanding it). This derived prescriptive instructional proposition is not, however, completely true and comprehensive. Of course, in order to secure that a learner memorizes a text better, it is important to make sure that he or she understands it or to teach him or her how to understand it. But understanding is just *one* of the conditions leading to better memorizing, and to secure (or teach) the understanding is *not sufficient* for gaining the best results in memorization. Other factors not mentioned in *these* propositions of learning theory (both descriptive and presciptive) should be taken into account. They are stated in other propositions of a learning theory (if it is complete). But the learning theory does not tell anything about which of its propositions should be taken into account and combined (and precisely how combined) in order to state an effective prescriptive instructional proposition (Landa, 1983, pp. 65-66).

A further confusion may emerge when learning theory and instructional design theory are confused. As Reigeluth, Bunderson and Merrill (1982) have pointed out, prescriptive learning theory is not synonymous with prescriptive instructional design theory. Because theory of instructional design focuses on *methods* of instruction it is relatively easy to apply in instructional/training settings. However, learning theory is more difficult to apply, because it focuses on the learning *process* and *conditions* of learning for which instruction must still be developed.

A final point of confusion often occurs when the instructional design "blueprint" is confused with the expectations for an instructional developmental model. Instructional-design blueprints "indicate *what* the instruction should be like, whereas development models indicate *how* to make it that way.... There is a very real important difference" (Reigeluth, 1983, p. 24).

In summary, given a defined training/instructional need or problem, the recommendation of an appropriate solution needs to be based on the realization that:

- only prescriptive instructional design theory places emphasis on methods and how information should be presented to a student.
- descriptive theories can not be *directly* translated into instructional practice.

2. Can we develop models derived from research and theory to help us define alternative solutions which consider:

   - reliability,
   - validity,
   - generalizability of research findings?

In the past, many researchers have interpreted the discovery of psychological effects to be a complete research finding (Salomon, 1974). Although this is appropriate in many fields, instructional research carries the added criterion of effectiveness (Salomon, 1974). The criterion of effectiveness is evident in the teaching of most educational research methodology courses in which students are cautioned to contemplate upon proposed findings and to ask, "So what?" This question goes beyond simple justification of the purpose of the study. By asking "So what?" a researcher questions the value of the effects as they relate to total instructional effectiveness. This added criterion of effectiveness in instructional research suggests that it is not enough for a problem-solver/researcher to study generalized effects alone (Salomon, 1974).

When considering the development of effective models from research theories several realities need to be addressed:

- Many theories have been developed outside the practical world of instructional development/design (Diamond, 1978).

- Researchers have tended to focus on studies of instructional "effects" rather than instructional "effectiveness" (Salomon, 1974, 1979).

- Theoretical contributions have been reduced by misplaced emphasis on gross media comparisons ("Research with media") as opposed to "Research on media" (Salomon & Clark, 1977). Research with media, e.g., TV versus film comparisons, have failed to provide knowledge about a specific medium, and the way that individual learners learn from the presentations.

- Practical research studies are scarce because of the difficulties in conducting classical experimental designs within the framework of day-to-day instruction (Clark, 1971; Diamond, 1978).

- Key limitations and problems associated with various theoretical models are rarely reported (Diamond, 1978). As Diamond pointed out probably we all have had the experience of discussing a model, theory, or program with its instigator only to discover major limitations which were omitted from what we had read or heard.

It is important to remember that research techniques designed to establish cause and effect relationships may not be suitable for studies of effectiveness. Research designs appropriate for laboratory-oriented research may impose "artificial and unrealistic constraints on decision-oriented (situation specific) questions" (Heinich, 1984, p. 84). The quasi-experimental approaches described by Campbell and Stanley (1963) are of growing importance to researchers in our field. Campbell and Stanley have stressed that when full-experimental control is lacking as in a quasi-experimental design, it is crucial for the researcher to consider those variables which the research fails to control. They recommend that the reseacher actually seeks out such threats to validity, so that there is a sound awareness of potential competing interpretation of the data. Confidence in the internal validity, reliability and generalizability of the research can be maintained. Diamond (1978), Heinich (1984), and others are calling for a movement away from experimental to more naturalistic, field-based studies. "I am not implying less rigorous study. In my view, a naturalistic study must be more disciplined, more perceptive, if less mathematical, than an experimental study" (Heinich, 1984, p. 85).

The writings of Gagne (1977), Snow (1970), Kaufman (1983), Merrill (1977), and Salomon (1979), to name a few, have attempted to provide insight for practitioners who in their day-to-day experience do not have time to investigate relevant research before implementing a solution to an instructional need/problem. A common perception is prevalent throughout these writings; that is, there is a need to derive principles, theoretical models, skeleton hypotheses as a basis for integrating research and practice.

Before the "knowledge user"/practitioner can apply effective instructional strategies, the "knowledge producer" must derive and validate prescriptive principles, and construct and test prescriptive theories and models of instruction. Reigeluth (1983) has extended Snow's (1971) theory-construction procedures. In Reigeluth's procedure the following steps were proposed:

Step 1: Develop formative hypothesis about instructional design on the basis of experience, intuition, and/or logic.

Step 2: Develop a taxonomy of variables related to instructional design. "It is usually best to start with a clear description of desired outcomes. Then, generate as many methods as you can for achieving those outcomes. Finally, identify different conditions that will influence which methods will work best" (1983, p. 31). In other words, this step involves identifying, describing and classifying variables that may impact instructional design theory.

Step 3: Derive principles of instructional design. This step relies heavily on experience, intuition systematic thought to postulate the principles and upon empirical research to test them.

The principles postulated in this step usually define cause and effect relationships among variables identified in the previous step which relate to formative hypotheses developed in Step 1.

Step 4: Develop models and theories of instructional design. As Reigeluth recommended "theories can be developed by integrating strategy components into models that are likely to be optimal for different sets of conditions and outcomes....the methodology is very different than that for deriving and testing principles. Stepwise multiple regression can be used to rank order the contribution of each strategy component to the instructional outcomes, when adjusted for all strategy components that contribute more" (1983, p. 31).

Reigeluth noted that the order of the preceding steps may change. For example, Steps 3 and 4 could be interchanged depending on whether an inductive or deductive approach was used. This procedure may form a promising basis for future development of models derived from research and theory.

3. Can we rely on the technology of our field to provide these solutions?

In order to find solutions to instructional problems, there must be a phase which emphasizes data collection and data analysis. The results of the analysis phase needs to be integrated into a subsequent phase of ongoing synthesis to facilitate development of a comprehensive theory (Martin & Driscoll, 1984; Reigeluth, 1983). We have an ever growing need to reap the benefit of knowledge produced within our field. We may meet this need through the use of synthesis and the recognition of commonalities across different philosophical perspectives. We need to meet the further challenge of how to reconcile seemingly opposing theories. As Clark noted:

> There are at least three factors that provide a very encouraging context for focus and integration of theory: First, there are simply too many design models with overlapping purposes, variables and predictions; second, to those who have surveyed many of these models there is clear if implicit agreement between many researchers on the type of variables that are important for a unified design theory (e.g., instructional methods, tasks and constraints such as individual differences); and finally, instructional psychology is ripe for a major attempt to reconcile behavioral and cognitive approaches to instruction and learning (1984, p. 120).

In a recent monograph, Reigeluth (1983) has incorporated concise descriptions of models provided by Merrill, Scandura, Gropper, Aronson and Briggs and other instructional design theorists. His work represents a timely contribution to a growing trend of attempts to synthesize information about instruction and learning into prescriptive models.

From the work of these authors and others, it is evident that knowledge, expertise and technology is available to those who wish to meet the challenge of integrating research and practice. What strategies should we employ to increase such interplay so that we can rely on the technology of our field to provide solutions? The following suggestions may provide appropriate direction:

1. Open Communications

   "Knowledge producers" need to promote open communications by:

   - developing formal and informal networks for an exchange of information across groups, i.e., psychologists, instructional technologists, designers, training developers, researchers, instructors, and administrators.

- establishing convention forums for work in progress, as well as completed studies (cf. Heinich, 1984).

- reporting results of appropriate studies in education and training journals as well as journals dedicated to research.

- promoting forums for "knowledge users" to express their problems (cf. Passmore, 1984).

- advocating the use of extensive analysis at the working level, only when there will be an increased return on the investment of time and resources (e.g. to determine why certain learners aren't learning versus across the board implementation) (Diamond, 1978).

- using professional judgement to avoid excessive discussion of complex models and theories with client-practitioners. As Diamond (1978) pointed out, practitioners need to understand the design process yet usually they are not interested in jargon, models, or theory.

> People whose role is primarily one of producing information are likely to be rich in only one of the various types of power. That type of power is expertise, and it must be carefully used to good advantage in establishing one's credibility, in opening up communication channels, and in garnering influence (Morell, 1984, p. 7).

2. Examine graduate instructional technology programs to ensure that the following needs are met:

- an emphasis on systematic problem-solving (cf. Plomp & Verhagen, 1983). With these skills, the graduate may be able to resolve the conflict between a knowledge producer's view of "what should be done," the practitioner's perspective of "what can be done," given real world constraints (e.g., time, budget, resource and informational limitations; organizational goals; biases and needs of decision-makers; incentives for change) (cf. Diamond, 1978; Morell, 1984).

- a climate of acceptance for dissertations based on naturalistic research methods (Heinich, 1984).

- exposure to successful models which have been integrated and used by practitioners (e.g., models developed by military research organizations).

- training to evaluate, compare and contrast the strengths and weaknesses of various theories, so that the graduate is able to defend a specified model, theory or process. That is, the graduate not only needs to understand the rationale behind the theory, but also the implications for application in their future work settings (Diamond, 1978).

- encouraging research and practice which seeks alternative ways to prevent instructional problems from occurring, as well as strategies to provide solutions for existing problems (cf. Davies, 1978).

- development of graduates who are skilled practitioners and reflective scholars (Heinrich, 1978).

3. Integrate the roles of those in our field.

As Reigeluth, Bunderson and Merrill (1982) advocated, we need to integrate the efforts of the "scientist" who discovers principles, the "technologists" who use these principles to develop procedures and heuristics, and the practitioner who uses these procedures and heuristics to develop instructional materials. This may be achieved by:

- placing research and development activities within the same organizational framework. Shoemaker (1984) proposed that these professionals be placed in close physical proximity to facilitate increased transfer of information.

Where do we go from here?

Ivor Davies (1978) has challenged our field to assert ourselves and begin a new growth pattern based upon opening up the possibilities available to use through aiming for effectiveness in all we do. As the result of many decades of research, we have accumulated a vast amount of information relating to theories of learning and instruction. It is reminiscent of a giant jigsaw puzzle with each piece of research information equivalent to each piece of the puzzle. The need for solutions to instructional/training problems requires that we as professionals are not only concerned with the discovery of more pieces, but also stress attempts to integrate these findings. As problem-solvers, we need to assemble the existing pieces within a picture which represents a macro-view of the science of instruction. Our challenge is to find "the picture on the lid" which will integrate the efforts of all professionals--the scientist and the technologist and the practitioner. This is our realistic challenge not our impossible dream!

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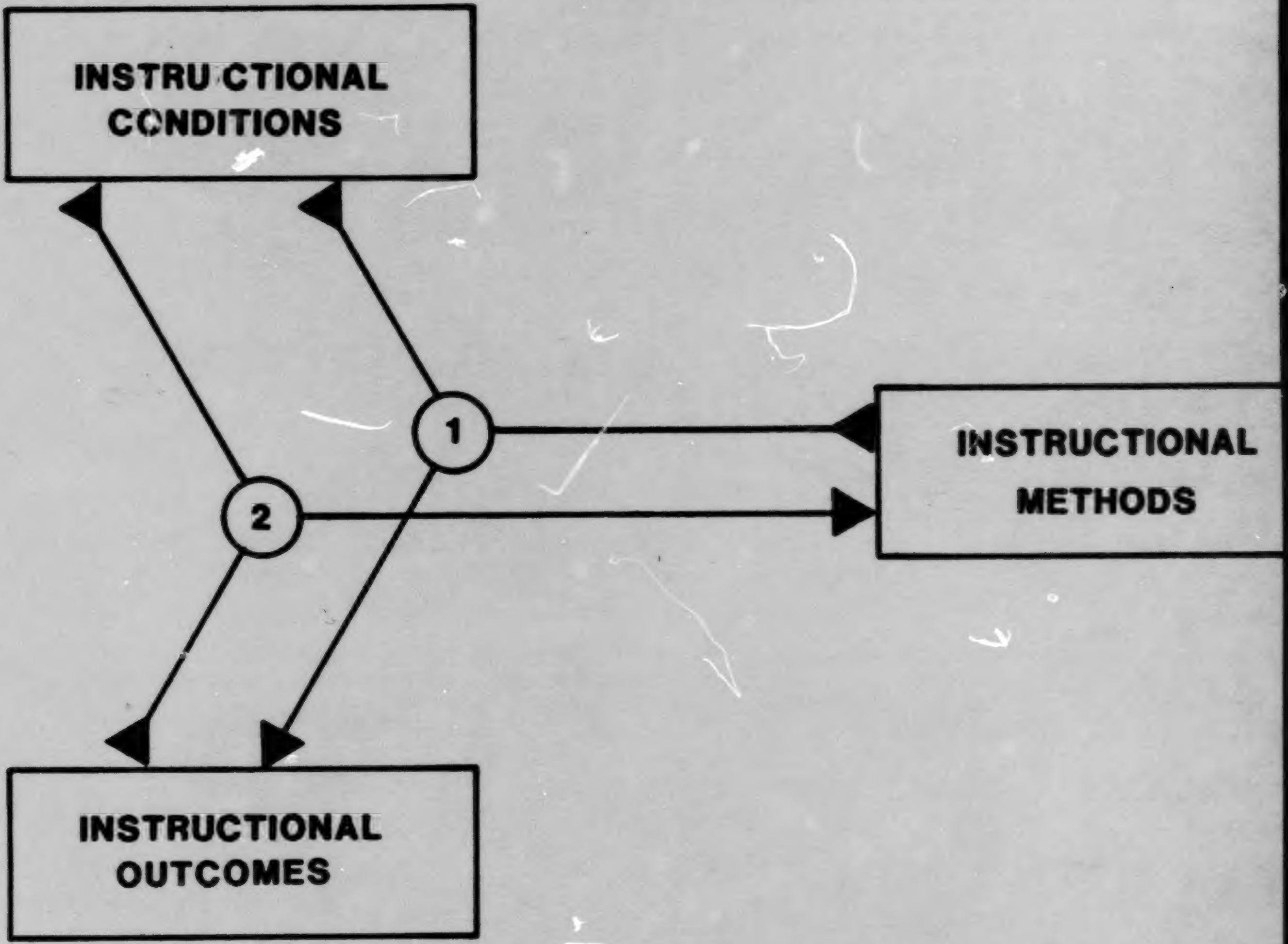
INSTRUCTIONAL CONDITIONS
1
INSTRUCTIONAL METHODS
2
INSTRUCTIONAL OUTCOMES

Figure 1 **Three categories of instructional variables, and two sets of interrelationships among those categories.**

Source: From INSTRUCTION-DESIGN THEORIES AND MODELS: AN OVERVIEW OF THEIR CURRENT STATUS, by C.M. Reigeluth. Lawrence Erlbaum, Inc. Hillsdale, New Jersey, c 1983.

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NEW TRENDS FOR NEW NEEDS IN INSTRUCTIONAL TECHNOLOGY: THEORY AND DEVELOPMENT

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PLAN

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CONCLUSION

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INTRODUCTION

Planning an educational action research is not easy, as I have learned in recent years. For my research studies I have conducted many interviews and collected various case studies; I have examined several educational action research projects. As a result, I can cite the case study as my best tool for clarifying meanings and working out strategies that can facilitate the planning and execution of a project. Thus, my research methodology has been based on case study strategies.

It is:

1 - Philosophical, with a survey of individuals' values;

2 - Anthropological, since these were the working tools of the participant observers; and

3 - Pedagogical, oriented toward research based on an educational milieu.

I have investigated the salient information about theoretical and practical approaches by researchers and studied their research problems.

The data I report here projects a macroscopic view focusing on the socio-historic and educational contexts of these projects. I call this approach anthropological, as is the microscopic view.

The latter, which illuminates the content of my survey in a different manner, links it with powerful ideas that include divergent and contradictory opinions, as well as descriptions of the educational milieux.

I The difficulty of conducting an educational action research project

In my research studies, I have found that conducting an educational action research project is not easy. Even well-organized school projects travel a perilous route. For instance, the "Education permanente à l'élémentaire" project (Continuing Education project at the elementary level) existed approximately five years, gained some international attention, and died. Some other projects, such as "Opération-Humanisation au Saguenay-Lac Saint-Jean" (Humanisation project at Saguenay), "PERFORMA" (In-Service Training project) at the University of Sherbrooke and so on, all had difficulties.

We may ask ourselves these questions: how can a research project be kept on track? When it is alive and well, what training, intervention and research dialectics are involved? What can kill an educational action research? Is it because researchers and participants fail to invest adequate planning? Are the research and intervention models inadequate? In the domain of human relations, is there any dissention among members? Are a combination of these internal and external factors creating a problem?

II The case study: a tool for collecting and analyzing data

I have decided that the case study method is my best tool for collecting different views about participants' experiences and finding out if a completed school research retains any meaning in the years following its completion. This method carries validity because, first of all, a case is a real experience taken from daily life; it is a problem situation needing diagnosis. Data must be collected, the whole context must by analyzed, and a problem solving mechanism must be divised. (Kemmis, S., 1980; Lippitt, G., 1980; Mucchielli, R., 1972; Stenhouse, L., 1980; Ardoino, J., 1980).

When I began collecting data about an educational action project, I gathered written documents such as reports, scientific tests, government grant forms, theses, and photographs, as well as audio-visual documents, such as audio and video cassettes. I analyzed this material in the light of my research problem: What is the life of an educational project with an action research orientation?

I also interviewed "key informants" of the project, taking notes and taping conversations of the school principal, school board administrators, teachers, parents, students and project researchers.

When interviewing participants, I always asked specific questions, such as: How did the project get started? What was occurring when it was alive? When did they join the project and what did they do?

Meeting only one person at a time, I conducted all my interviews in quiet places, eg. an office or a living room. To my data, I added a personal journal in which I wrote my observations about my interviews, their circumstances and milieux, and so forth.

2.1 The analysis

After describing the action research project, I analyzed my data with an eye for action research procedures, the pedagogy employed, evidence of participants' value systems, and so on.

2.2 Example of a Macroscopic view: the Continuing Education project at the elementary level ("EPEL")

2.2.1. A look at the 1970's in Quebec education

> "EPEL" was an experimental project in which school administrators, teachers and researchers questioned teaching methods, innovative pedagogies, teacher and student attitudes and behaviors. (Angers, 1978: 225).

To more fully understand this project, we must note that in the 1960's Quebec society experienced a major cultural revolution. Participants of the "EPEL" project were its products.

The predominating ideology during the 1960's was deeply rooted in theological and sociological thought. Grand'Maison writes:

> The school appeared an important symbol, ensuring survival of the christianity of these Catholics in

> the face of an anglo-saxon Protestant world. Social Institutions and values were evaluated on a religious basis (...). The Quebec Christian ideology was concentrated in the world of culture. Government policies worked on this orientation. With the Parent's Report on Education and the creation of the Department of Education, the focus shifted from the church to the secular authority, that is, the government. (Grand' Maison, 1970: 35).

With the "revolution tranquille" (quiet revolution) a participative and developing ideology immerged with the aim of preserving a culture different from that of other North American groups (Rioux, 1973).

This historical background influenced the "EPEL" group's educational policies and models. For example, the Parent Report on Education counsels emphasis on the quality of teaching rather that quantitative aspects; it urged development of thinking skills and analytic attitude. (Parent, 1966, T. 111: 191-203)

With this in mind, "EPEL" researchers set about to influence the qualitive aspect of education.

2.2.2 Pedagogy in the province of Québec

Today we talk a great deal about educational models (Lepine, G., 1977) and paradigms (Bertrand et Valois, 1982), but in the 1960's Quebecers talked more about educational concepts and ideological orientation (Paquette, 1976; Parent, 1966; Angers, 1978). Some educational orientations predominated. Among them were the classic pedagogy or traditional instruction in which students functioned under teacher control. "Free teaching" was a non-directive strategy (Benjamin, 1982; Paquette, 1976), "Open teaching", which was more restrictive than the latter (Paquette, 1976; Paré, 1977), featured several orientations, among them organic pedagogy, on which the "EPEL" project was based.

"EPEL" researchers described their pedagogy in the following manner:

> Organic pedagogy puts an emphasis on developing insights and autonomy. This pedagogy liberates because it opens imaginative and creative ways to the students. It is a stimulus which encourages understanding and the intuitive powers.
>
> The student becomes a self-educator who learns by means of human interactions in a conductive educational environment.

2.2.3 Educational research in Quebec during the 1960's

Education researchers in Quebec discovered new ways during the 1960's. Different reports about education urged work on new approaches, such as joining theory and action, affectivity and intelligence, to use the jargon of the times.

After a conscientization about the accessibility of knowledge, action research took foot. It resolved the scientist's ideological problems of joining theory and practice; rather than separating them as in classical research, it combined affectivity with the cognitive domain.

"EPEL" researchers strove to adapt their project to ideas current in their new Quebec society, thus initiating an action research (Angers, 1978).

2.3 MICROSCOPIC VIEW

This part of the case study deals with "EPEL's" history, objectives, ideology, human resources, physical circumstances, and participants: parents, students, teachers, principal, school board administrators, and project researchers.

According to the "EPEL" researchers, their project started in the autumn of 1970 with a meeting between the Three Rivers School Board and University of Quebec administrators at the local campus. They wanted to create a research project that would link educational theory with practice. As they needed a school to realize the experimental part of their project, Star Elementary School was designated (Angers, 1973: 1).

This school was in a crowded low-income area in Three Rivers, a city of 200,000 inhabitants. Around Star Elementary School, there are factories, many two or three level houses and the Saint Lawrence Seaway. One side of the school is bounded by playground and the other sides by streets.

In this area some people are chronically unemployed and must rely on government help. Many children from such families attended Star when "EPEL" was going on. Almost all the teachers and administrators lived in other parts of the city.

2.3.1. Objectives

The project's objectives were to study (1) various aspects of learning activities; (2) the human being; (3) the meaning of learning and teaching, especially when teacher attention is given to each individual student; and (4) the duties of students and teachers (Angers, 1971: 1).

At the ideological level, "EPEL" researchers wanted to study the factors that influenced relations between the school, its parent board and external institutions such as the Department of Education.

2.3.2. Analysis: vertical and horizontal readings

Under the vertical readings, I discuss the interviews, pointing out major statements - - eg. concurrence and differences in viewpoints - - by key informants in the same group, such as teachers or parents. With the horizontal reading, analysis in based on the opinions and efforts of all key participants. Finally, my concluding section links the data revealed by the participants with "EPEL's" socio-historical and educational context and the theories proposed by its researchers.

2.3.3. Example of the "EPEL" analysis: vertical reading

I interviewed school board administrators, principals, researchers, parents, students and teachers who participated in "EPEL". Figure 1 shows us their main comments. Administrators, were deeply implicated as leaders of the project. The acknowledged feeling too much involved in both the school and the researchers' work. They expressed the belief that Star School deserved to have played a larger voice in "EPEL's" planning.

FIGURE 1

MAIN POINTS IN PARTICIPANTS' INTERVIEWS

ADMINISTRATORS	RESEARCHERS	TEACHERS	PARENTS	STUDENTS
- EPEL squeezed us very much. - We experienced better interpersonal communication and human relations. - We developed a participative management throughout the whole school board. - Worked as equals. - We felt too involved in both the school and the researchers' work. - Administrators' leadership was too strong. - Administrators and researchers imposed the project, failing to elicit collaborative agreements and ideas with Star personnel.	- Communications between all involved groups influenced us. - We were involved with different participants at various levels each year. - Our researchers' leadership was excessive. - We planned the research primarily with the administrators only.	- We improved human relations, talking with and understanding each other better. This humanized Star School. - We were not committed as much as we wished because EPEL was imposed on us. - Researchers' ideal were too theoretical. - We created learning materials, experienced organic pedagogy in classrooms, and received a training in pedagogy.	- We enjoyed the welcoming attitudes of researchers and teachers at Star School and the possibility of starting a parents' school committee. - We did not feel involved enough in planning. - We were well informed about EPEL, however.	- We remember the atmosphere of freedom at Star School which facilitated communication between students and teachers. - We realize that we achieved greater autonomy in comparison with our friends in other schools. For instance, we are better prepared to do research by ourselves. - As soon as EPEL was operating, the classroom environment changed for the better.

2.3.4. Example of the "EPEL" project: horizontal reading

2.3.4.1. "EPEL" and action research

The French researcher and practitioner Henri Desroche, and his English colleague Checkland, describe action research as a collective work of planning by researchers and participants. It implies also a mutual search to resolve a problem, the diagnosis of which is oriented toward participants' needs. (Desroche, 1978; Zuniga, 1981; Barbier, 1979; Morin, 1981).

Prof. Desroche says that there are several action research strategies. The first one, Action Research "ON" (explanation); it studies an action without the factor of field experience, and is oriented toward the researcher's analysis. The second strategy is Action Research "For" (focuses on application). Agents work for the participants, presenting analyses and working strategies. There is also, Action "With". Agents work with the participants, planning the action research together.

2.3.4.2. Diagnosis of problems

After analyzing the Star School situation, researchers defined its problems. They noted that the area was economically poor and that its occupants were considered "tough" and socially deprived. After "EPEL" began, Star School administrators reported less vandalism such as broken windows than the prevailing level. Teachers probably invested with their students' different work habits, but they had accommodated themselves to these behaviors.

Action and research

During a six month period, researchers continued to examine Star's problems through participant observation techniques. They then proposed tentative solutions to teachers and administrators in training sessions about organic pedagogy.

Researcher Mathieu told me "It was our objective to test our theory in an educational setting. Whenever we introduce new educational models, we need to train teachers . . . Classrooms need to be completely transformed, especially by modifying teachers' pedagogical attitudes.

The teachers, however, judged the researchers' approach to problems was too theoretical and regretted that they had not been invited to plan collaborative strategies with them. Despite their reservations, they accepted help, although they did not solicit it.

Parents told me that they enjoyed being more welcome at Star School and they approved of the freedoms that were initiated. However, they were dissatisfied about not having been involved in planning "EPEL".

As Figure 1 reveals, administrators felt quite the opposite about their role.

The researchers did not impose their demands but tried to elicit cooperation, receiving it in varying degrees. These responses show that action research is more effective and far more pleasant for participants when the latter group not only executes plans but helps to devise them. Thus teachers, parents and administrators who, in this case, felt too deeply involved in planning (execution) would have experienced greater satisfaction, (perhaps would have modified project).

CONCLUSION

In this paper, instead of explaining the methodology of many educational (action research) oriented projects in Québec (which I have studied) I have decided to deal with only one case study to show the contribution of this method to human development, needs assessment, curriculum development and innovative teaching. Using the case study method, I understood and analysed the dynamics of other projects and gain a holistic view of them.

My approach is a design which will permit us to take an insightful look at current needs in instructional technology. The fundamental requirement, however, is to work methodically with a tool in which the researcher plays the critical role; his/her subjectivity must be valued, and empathy with subjects must be viewed as essential (Morin, A., 1979: 58).

Using case studies in my research permits me to pinpoint the essential conditions of some aspects of action research, which can facilitate the development of appropriate pedagogical models for today. The case study method itself is not new, I believe its use in instructional technology reflects a new trend, at least in my part of Canada, which can advance educational theory and research.

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The Effect of Adaptive, Advisement, and Linear CAI Control Strategies On the Learning of Mathematics Rules

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Running head: CAI Strategies

Abstract

The purpose of this study was to examine the effects of the locus of three computer-assisted instruction (CAI) strategies on the accuracy and efficiency of mathematics rule and application learning of low achieving seventh grade students. The three CAI treatments were an externally controlled adaptive strategy, an individually based learner control with advisement strategy, and a no control linear design strategy. Effects were examined for CAI strategy, prior achievement, and sex of student. Significant differences were found for achievement and the achievement by scale interaction, with the below average group yielding better rule recall and proportionately greater application scores than low students. The no control linear strategy, however, required less time to complete and resulted in the most efficient treatment.

The Effect of Adaptive , Advisement, and Linear
CAI Control Strategies
On the Learning of Mathematics Rules

In recent years many studies have dealt with various issues in computer assisted instruction (CAI). In general, CAI has been found effective in increasing performance, improving learner attitudes, and reducing time-on-task (Kulik, Bangert, & Williams, 1983; Kulik, Kulik, & Cohen, 1980). The locus of control in CAI design, learner, computer, or combined control, has been a recurring, but as yet unresolved, issue. The amount of control that learners can effectively manage, and the factors likely to affect control strategies, are not generally known.

Most studies which address instructional locus of control focus on either external program-level adaptive control (Ross & Rakow, 1981; Rothen & Tennyson, 1978; Tennyson & Rothen, 1977) or internal learner control with varying amounts of advisement (Ross, Rathow, & Bush, 1980; Tennyson, 1981; Tennyson & Buttrey, 1980). Adaptive computer control is typically regulated from within the program, dependent upon the learner's prior knowledge, accuracy of responses during the instruction, or lesson achievement status. Learner control usually incorporates a form of advisement, which informs the student about progress towards mastery, and a prescription for full mastery (Tennyson & Buttrey, 1980). The procedural decisions during the instruction, however, are typically under individual learner control. Whereas several CAI control strategies exist, the relative effectiveness of various control strategies has not been studied.

Several factors are likely to influence learning from CAI. Prior student achievement was a key influence on the amount of instructional support needed for optimal learning (Tennyson & Rothen, 1977; Ross & Rakow, 1981). Students with high ability or prior achievement performed best under learner controlled instruction, while low ability students required the externally imposed program control. In 1981, Tennyson demonstrated that average and above average high school students effectively managed their CAI when provided continuous advisement as to achievement and instructional needs. It is not known to what extent such strategies affect the performance of younger or less able students.

The nature of the learning task is also likely to exert a controlling influence. Several authors have noted that effective rule teaching procedures require instances of rule information, application, and practice (cf. Scandura, 1972; Tennyson & Tennyson, 1977). The strategies for teaching rule use and application are different from those used to teach other skills (Gagne, 1977), and require study for computer-based instruction.

The influence of sex differences, especially related to mathematics, is also of importance (Armstrong, 1981; Benbow & Stanley, 1980; Fennema & Sherman, 1977,1978). Whereas such achievement differences may be diminishing (Levine & Ornstein, 1983), considerable controversy remains. If such differences are moderated by sociocultural influences, such as tacit teacher-student interactions, then CAI might be effective in controlling subtle biases. Presumed mathematics-related sex differences, and the influences of various CAI design strategies on such differences, should be considered.

Several empirical and practical issues related to the design and effectiveness of CAI warrant study. The purpose of this study was to examine the effects of externally versus internally controlled CAI design strategies on the mathematics rule learning, retention, and efficiency of low achieving junior high students.

Methods

Subjects

A total of 47 seventh grade students, enrolled in low-achievement remedial mathematics classes, participated in the study. Class placement was based upon poor performance on a standardized test, the Comprehensive Test of Basic Skills, which was administered eight months prior to this study. Students were drawn from a middle-class school system, consisting of a majority of Anglo and a minority of Hispanic and other ethnic group representation.

Instructional Materials

The instructional task selected for this study was a mathematics rule lesson concerning divisibility by two, three, and five. Each treatment consisted of the same basic tutorial CAI program, designed to teach the rules for divisibility by two, three, and five, and the application of these rules to five and six digit numbers. The lesson structure was based upon the "Events of Instruction," and adapted to CAI (Gagne, 1977; Gagne, Wagner, & Rojas, 1981). Three versions representing different CAI design strategies were developed.

Adaptive control. This version consisted of externally controlled CAI, during which the computer branched students for reteaching or more examples, dependent upon the accuracy of responses during the lesson. Students completed the entire CAI program before exiting the lesson. Students had no control over the pacing or amount of teaching in the lesson. All control for this lesson was externally regulated through programming commands; students advanced only when correct responses were made and mastery levels were attained.

Learner control with advisement. This treatment consisted of internally controlled CAI, during which students were continuously advised of progress toward objectives, but permitted to determine if reteaching, additional examples, or additional problems were needed. Students were advised that they should answer at least four problems correctly before advancing to the next section. However, students were free to continue to the next rule at any time after the tutorial portion of each section.

No control. This treatment served as control for the study. Students using this strategy received the same sequence of instruction and examples but had no advisement, no individual control to review or to select additional examples, and no externally imposed program decisions based upon the accuracy of responses. Students were only able to control the pace of the instruction by advancing through the presentation when ready. This treatment was linear CAI, which permitted the student only to follow the predetermined instructional path. Each student was required to complete the entire lesson before proceeding.

Recall and Application Tests

Immediate posttest. A 25 item five-part multiple choice written posttest was administered to each student upon completion of the CAI program. The written test included eight questions which tested rule recall and 17 questions which tested the application of the rules for divisibility by two, three, and five. Recall questions required students to recall the test rules in various forms. Application questions required students to select the correct four, five, or six digit number which was divisibile by one or more of the test numbers. Test numbers of this size were chosen to assure that students could not easily determine the answer without applying the rule.

Parallel retention test. A parallel multiple choice test of 25 questions was given to test retention of rules and ability to apply rules learned from each CAI strategy. The parallel test was identical to the immediate test in form, item number, and item type. Each of the items included on this test was designed to mirror a corresponding item from the immediate test, except the numbers and context used to elicit the rule were different. The forms were validated for equivalence through a series of item evaluations conducted independently by two researchers.

The reliability of the achievement tests were established prior to the study by administering the immediate posttest, then the parallel retention test one week later, to 55 eighth grade students. The parallel form reliability of the test was .67.

Teacher Survey

For each student, the student's current mathematics teacher rated mathematics ability in relationship to other seventh grade students. A five part rating scale, with values ranging from low math ability to high math ability was used in this rating. The survey provided information about student mathematics capabilities to assure that all students selected for this study were below average mathematics performance.

Dependent Measures

Dependent variables were immediate posttest and retention test scores for both rule recall and rule application. In addition, the number of minutes spent on the instructional task was collected for each student, and analyzed both separately and with test scores as an indication of learning efficiency. The learning efficiency score was a measure of the ratio of number of correct responses on each rule and application test, divided by the number of minutes required to complete the instruction.

Procedures

Standardized mathematics scores and teacher ratings were gathered for each student prior to the study. The 20th percentile was the median score for the 47 students, and was used to classify students as "below average" or "low" in prior mathematics achievement. Those students below the 20th percentile were classified as low, and those above the 20th percentile as below average, achievement for the purposes of this study. The teacher ratings were used to corroborate these classifications. In cases of inconsistency between teacher ratings and standardized test scores, student data were excluded from the analysis.

Prior to the study, the researcher provided general information to the students as to the purposes and expectations of the study. During this time the students were instructed in the elementary operation of the microcomputer to be used in the project and were given a short time to interact with another CAI lesson similar procedurally to the lesson used in the present study.

The students were randomly assigned to one of the three treatment groups, stratified to ensure that approximately equal numbers of males and females with low and below average achievement were assigned to each treatment. Students were directed to one of five microcomputer stations, and the corresponding CAI lesson was provided. Each student received a brief review of computer operation and was instructed to proceed with the lesson. At the conclusion of the lesson the elapsed time was noted and the immediate posttest was administered.

One week later students were given the parallel retention test in their classroom. Only students who were present during all phases of the study were retained for data analysis purposes.

All tests were scored using "blind" scoring procedures after the delayed retention test was completed. Separate scores were obtained for rule recall and rule application for each test administration.

Design and Data Analysis

This study used a 3 x 2 x 2 between subject factorial design with two additional within subject factors. The between subject factors included three levels of CAI strategy (adaptive control, learner control with advisement, and no control), two levels of achievement (low and below average), and sex of student. The within subject factors included test scale (rule recall and rule application) and test interval (immediate and retention).

Data were collected for each student on each of the two scales, for both immediate and retention tests. In addition, time on task data were collected during instruction. A learning efficiency index, the ratio of test score to time on task, was also computed and analyzed.

Data were analyzed using MANOVA procedures for repeated measures designs. The MANOVA procedures were used to analyze the effects for rule recall and rule application as well as for learning efficiency. ANOVA procedures were used to examine effects for differences in time on task. Comparisons among treatment means were accomplished using Newman-Keuls pairwise contrast procedures.

Results and Discussion

Rule Recall/Rule Application Effect

The mean scores for rule recall and rule application scales for immediate and delayed tests are contained in Table 1. A significant difference related to prior achievement was found, $F(1,34)=16.74$, $p<.0005$. The below average students consistently scored higher than low students across all CAI strategies. In addition, a prior achievement-by-scale interaction, illustrated in Figure 1, was also detected, $F(1,34)=6.63$, $p<.01$. Below average students scored higher across both the rule and application scales, but proportionately higher on application items. No differences were found for CAI control strategy.

As expected, a significant difference was also found between test intervals, $F(1,34)=6.31$, $p<.01$, which was characterized by a uniform decline in test scores over time for both treatments and scales.

Insert Table 1 and Figure 1 about here

Time on Task

A significant difference was found for CAI strategies, $F(2,38)=15.80$, $p<.001$. The no control strategy averaged significantly less time to complete (9.0 minutes) than both the externally controlled adaptive strategy (12.4 minutes), $p<.05$, and the internally based learner control with advisement strategy (16.3 minutes), $p<.01$. The time differences between the adaptive and advisement strategies were also significant, $p<.01$.

A significant effect was also detected for prior achievement, $F(1,38)=4.88$, $p<.05$. Below average students used less time to complete treatments (mean score = 11.35) than low achievement students (mean score = 13.96).

Learning Efficiency

The mean scores for learning efficiency are contained in Table 2. Several significant differences were detected. Learning efficiency differences were found for CAI strategy, $F(2,34)=6.41$, $p<.005$, and prior achievement, $F(1,34)=16.22$, $p<.0005$. The no control strategy was the most efficient (.70 concepts/minute), followed by the adaptive strategy (.51 concepts/minute), and the learner control with advisement strategy (.36 concepts/minute).

Although below average students were more efficient than low students, a significant interaction also was found between test scale and prior achievement, F(1,24)=8.37, $p<.01$. This effect is illustrated in Figure 2. The below average students were more efficient than low students on both scales, but proportionately better on applications.

Another significant difference was evidenced by the interaction between control strategy and test interval shown in Figure 3, F(2,34)=3.64, $p<.05$. The efficiency of the no control strategy treatment dropped significantly from the immediate to the retention test, while both adaptive and learner control strategy treatments remained more consistent in their efficiency. No other significant main effects or interactions were found.

Insert Table 2, Figure 2, and Figure 3 about here

General Discussion

Previous research has not addressed adequately the effects of various CAI control strategies on the performance of low achievers. The purpose of this study was to examine the effects of the locus of control of CAI design strategies on the mathematics rule learning of low achieving junior high school students. The results indicated that low achieving students learn comparably under internal, external, and no control strategies, but perform most efficiently under imposed no control linear strategies.

Several points warrant discussion. The issue of achievement versus efficiency of learning was a key feature in this study. Whereas no differences were found for achievement resulting from the different design strategies, both instructional time on task and the associated acquisition rate were affected significantly. The adaptive and advisement CAI control strategies used in this study required greater learner time to complete, with no associated gain in learning. The basic linear design yielded comparable learning coupled with significantly less instructional time. Given these findings, a convincing argument can be offered for the functional superiority of simple linear design models for low achievers.

In previous studies, reported by Tennyson and associates, the increase in instructional time has proven worthwhile: learning for older and more able students was improved in direct relationship to the control strategy and amount of instructional time invested. The patterns obtained for the younger and less able learners in this study, however, may indicate that previous research on instructional control strategies is of limited generalizability for this population. Both the age and prior achievement characteristics of the present sample were intentionally different from earlier studies. The age and capability differences resulted in effects that were clearly different from those of earlier studies.

Performance differences may be attributable to several factors. Younger and less able students have less background knowledge in the content area of the instruction, and consequently are less effective in making judgements as to their progress and need for additional instruction. This background is required for effective interaction with learner controlled strategies. Strategies that continuously re-route learners through instruction that was inadequate in teaching concepts initially may also be undesirable. Low achievers may derive maximum benefit from the initial presentation of instruction, and may experience dissonance upon re-exposure to information not learned initially. In the present study, the comparable learning across CAI strategies suggests that little was gained by routing learners through either internally governed or externally controlled options.

Linear strategies, on the other hand, move learners through identical instructional paths, based upon the logical sequence of information, practice, and other features. Linear CAI requires neither learner judgement of the need for additional instruction nor re-routing through instruction that has been ineffective. Since low achievers are more likely to require the complete sequence of instruction, and are not likely to require, or profit from, the multiple options and decision points of more advanced learners, they may need different, more basic instructional features. In effect, the initial "pass" through the instruction may be the most effective for low achievers, rendering multi-optioned and heavily branched CAI of little additional benefit. Based upon the findings of the present study, simplified but powerful linear designs, that combine learning effectiveness and efficiency, may be the most desirable option for low achievers.

Of further interest was the lack of influence exerted by the CAI strategies compared with the more powerful prior achievement history of the learner. The test score variance-accounted-for by the different CAI strategies was roughly one percent. Prior achievement, on the other hand, accounted for approximately 30 percent of the observed score variance. Clearly, the impact of different control strategies in the face of prior learning was inconsequential. Even if reliable learning differences among control strategies could be obtained, it is unlikely that such a strategy would be substantially more efficient than a linear strategy.

In cases where the information to be learned is sufficiently important, the cost of additional development and instructional time may be warranted. Under most circumstances, however, this is not the case.

In most public educational settings, for example, skills and concepts are taught through a variety of means. CAI is rarely used as the primary or sole instructional delivery system, assuming instead a supplementary function. It seems impractical to expect that that the significant additional expense of high cost, low gain CAI should be assumed given the relatively small increments such designs produce versus simple, but powerful, linear designs. The most straightforward and inexpensive design strategies will likely yield the most efficient solutions for low achievers, and are likely to be more readily designed, produced, and installed into typical instructional settings.

The sensitivity of the achievement classifications used in the present study to differences in learning is also important. Several effects involving the prior achievement levels of the students were obtained, suggesting that considerable heterogeneity existed within presumably "low level" tracked classes. Educators have often argued that remedial classes, such as those used in this study, provide homogeneous learners with respect to instructional style, skill levels, learning rate, and learning style. These arguments may be weakened in view of the findings of this study. Even within the restricted range of test scores defined as prior achievement, the more able learners obtained significantly higher rule recall scores, were quicker and more efficient during acquisition, and applied mathematics rules to numeric problems with proportionately greater accuracy than the very low achievers. The universal instructional approach often sought for low achievers may be not only impractical, but misleading as well.

The absence of effects for sex of student may indicate that male and female low achievers are more similar than their normal and high achieving counterparts. The male-female achievement differences, beginning roughly at the academic grade level of the students participating in the present study, are well-documented for the general population. For low achievers, however, gender does not appear to differentiate the effectiveness of control strategies, or to affect the magnitude or efficiency of mathematics learning.

The true effects of varied CAI instructional control strategies on the mathematics rule learning of low achieving junior high school students may be related more to the efficiency than the magnitude of learning. The methods employed, and questions addressed, in this study have permitted the inclusion of two important practical instructional dimensions not typically evaluated: time and efficiency. These are important dimensions, and represent a departure from the manner in which learning and instruction issues are typically studied. Perhaps future attempts to study the effects of CAI and other instructional delivery systems will move closer still to the merging of empirical and practical concerns.

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Table 1

Mean Scores for Rule Recall and Rule Application Achievement

	Rule Recall				Rule Application			
Prior Achievement	AC	LC	NC	TOTAL	AC	LC	NC	TOTAL
				Immediate Test				
Low								
Female	6.0	5.3	4.0	5.1	7.5	7.3	5.3	6.8
Male	4.4	4.0	4.5	4.3	6.4	6.0	6.0	6.2
Below Average								
Female	7.8	4.7	5.5	6.1	11.3	8.0	10.0	9.9
Male	6.3	6.5	7.0	6.7	8.7	9.3	11.3	10.0
Total								
Female	6.9	5.0	4.9	5.6	9.4	7.6	8.0	8.4
Male	5.1	5.5	6.0	5.6	7.3	8.0	9.2	8.2
				Retention Test				
Low								
Female	4.3	4.3	5.0	4.5	8.0	5.8	5.0	6.2
Male	3.8	4.8	4.0	4.2	6.8	5.0	5.0	5.8
Below Average								
Female	6.3	3.8	5.0	5.0	11.7	6.7	7.8	8.6
Male	6.3	5.8	5.5	5.8	9.3	10.0	8.2	9.1
Total								
Female	5.3	4.0	5.0	4.8	9.8	6.1	6.6	7.4
Male	4.8	5.3	5.0	5.0	7.8	7.8	7.1	7.5

Note. AC - Adaptive Control LC - Learner Control with Advisement

NC - No Control

Table 2

Mean Scores for Rule Recall and Rule Application Learning Efficiency

	Rule Recall				Rule Application			
Prior Achievement	AC	LC	NC	TOTAL	AC	LC	NC	TOTAL
				Immediate Test				
Low								
Female	.42	.33	.50	.41	.52	.45	.55	.50
Male	.32	.21	.57	.35	.49	.33	.60	.47
Below Average								
Female	.75	.29	.58	.54	1.07	.44	1.08	.89
Male	.67	.55	.94	.74	.98	.82	1.54	1.16
Total								
Female	.59	.31	.55	.48	.80	.45	.85	.70
Male	.45	.40	.82	.56	.68	.60	1.23	.84
				Retention Test				
Low								
Female	.34	.27	.63	.40	.62	.38	.48	.48
Male	.27	.25	.46	.31	.51	.28	.56	.44
Below Average								
Female	.63	.22	.51	.46	1.17	.42	.80	.80
Male	.65	.48	.74	.63	1.02	.80	1.16	1.00
Total								
Female	.48	.25	.56	.43	.89	.40	.66	.64
Male	.41	.38	.65	.48	.70	.57	.96	.75

Figure Caption

Figure 1. Mean achievement for below average and low students on rule recall and rule application tests.

Figure 2. Mean learning efficiency for below average and low students on rule recall and rule application tests.

Figure 3. Mean achievement for no control, adaptive, and learner control strategies on immediate and retention tests.

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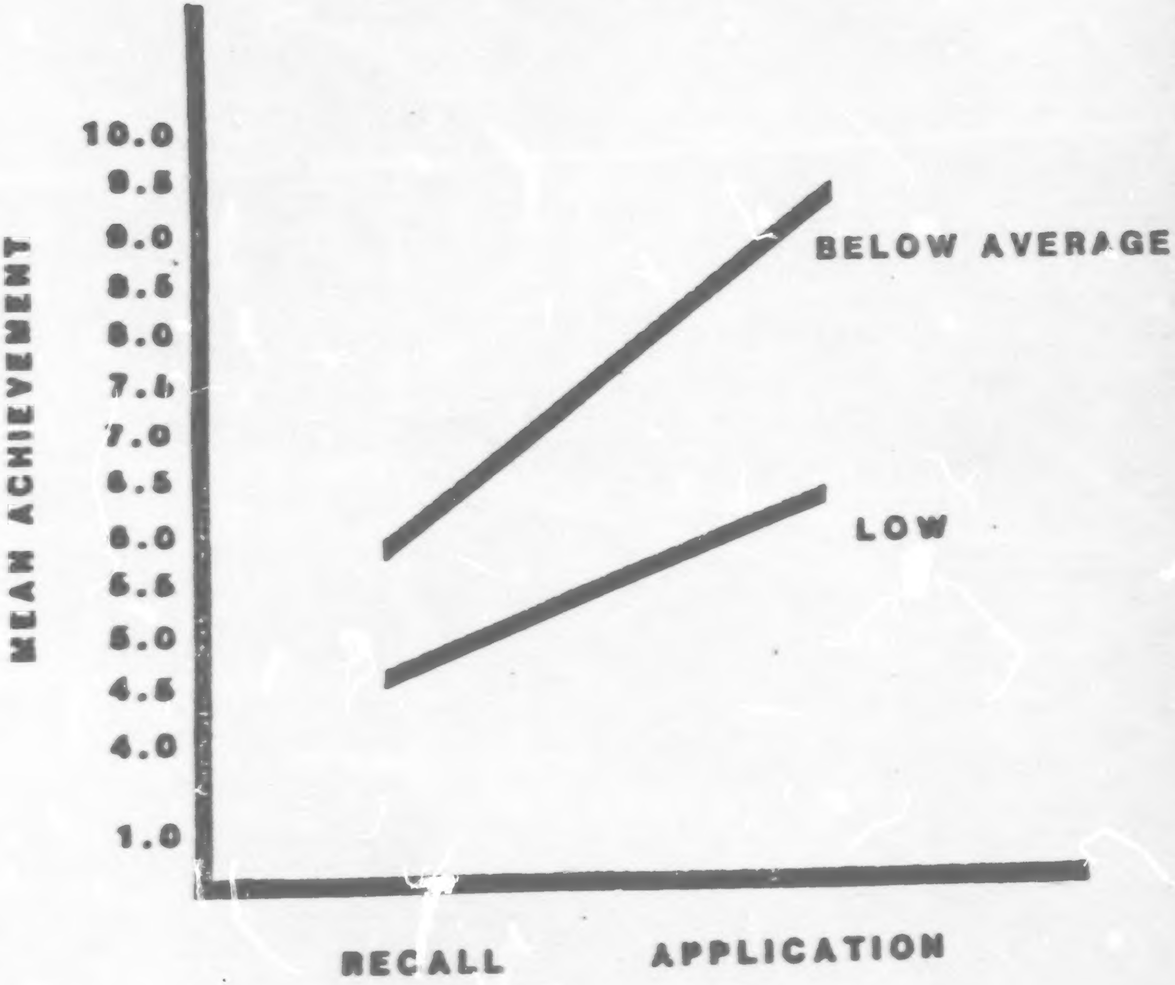

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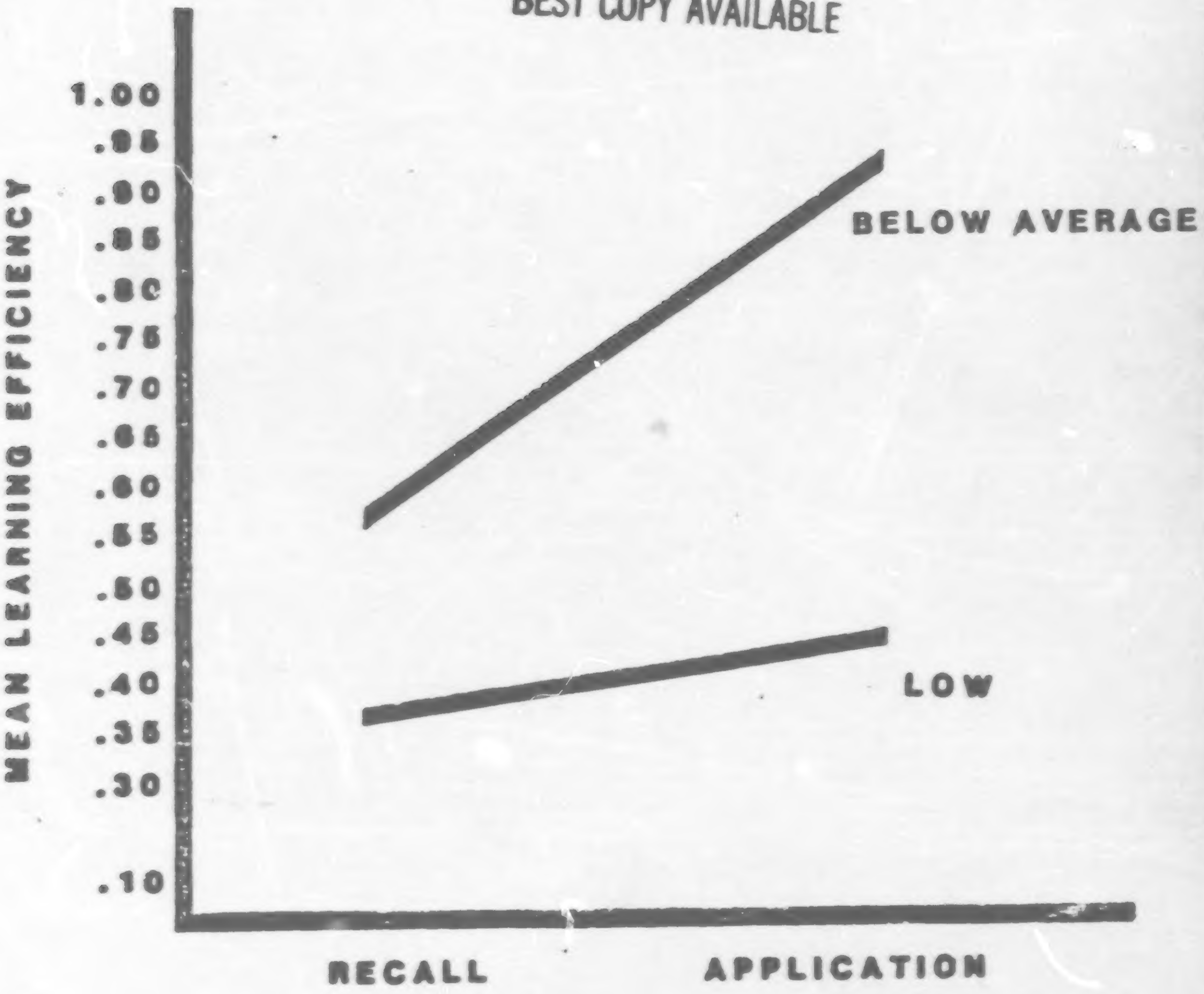

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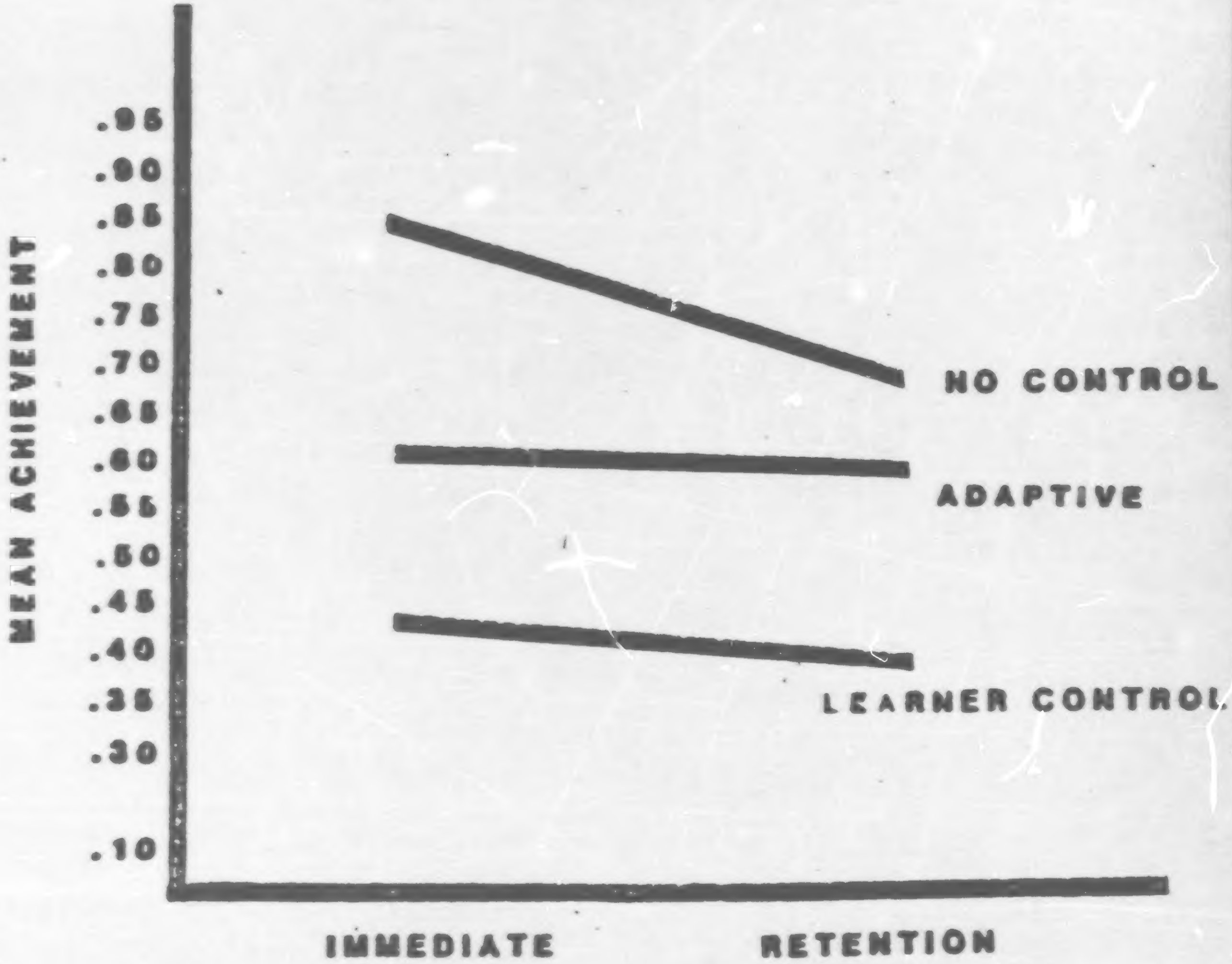

CRT Text Layout: Prominent Layout Variables

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Chapter 1

Problem

Legible text, whether presented via paper or Cathode Ray Tube displays (CRTs or VDTs) possesses three qualities: symbol visibility (clarity), symbol recognizability (perceptability), and overall comprehensibility (readability) (Reynolds, 1979). A legible display combines the writing of the author with the screen design skills of the publisher. An author can refer to the rules of grammar, spelling and, usage for assistance in writing an understandable message. However, the publisher lacks the same advantage of formal rules or guidelines when combining the text elements that present the author's writing, using instead a combination of artistic principles, folklore, tradition, and economic restrictions.

Art, tradition, and folklore contribute to an attractive layout which is useful in gaining and keeping a reader's attention. However, attention is only one part of the perceptual process in learning from instructional text. Neisser (1976) describes perception as a cycle where the perceiver reacts to the environment (nominal stimulus) by seeking out meaningful information and integrating that information into an existing schema. Written text presented on a CRT display is a nominal stimulus where reading is the primary means of acquisition. Reading, too, is a continuous cycle that requires attending to a stimulus, encoding the stimulus in a meaningful manner, and linking the meanings with existing knowledge or prior experience (Tinker and McCullough, 1962).

The cognitive link between reading and perception is important because it defines a psychological area that may be used to identify processes used by readers in perceiving CRT text and, it sets as a design objective the accurate translation of a nominal stimulus into an effective stimulus. Text should be formatted in ways that facilitate the total perceptual cycle, not just the attention process. Research aimed at meeting this objective has centered on the visibility and recognizability characteristics of text.

Visibility and recognizability contribute to awareness and encoding. Works by Tinker (1963, 1965) and later updated by Rehe (1979) cover the area of visibility quite thoroughly. These findings are usually widely practiced, since a publisher who does not produce visible materials will not be a publisher for long. Although these same standards are frequently used for CRT text displays, the generalizability of paper standards to the CRT has not been verified. Visibility and recognizability research specific to the CRT has established brightness, contrast, and letter size as well as letter shape and dot matrix size. (See Grabinger, 1984 for a summary of these findings.)

Research aimed at enhancing the comprehensibility of a document has been done with directive cues, chunking, organizers, and text layout. The most successful of this research has been with directive cues finding that directive cues (e.g., underlining, italics, bold type) facilitate certain types of learning under the following conditions: first, the cues must be systematically related to desired outcomes (Crouse and Idstein, 1972 and Anderson and Faust, 1967); second, the cues must be used sparingly to indicate only those ideas which are superordinate (Hartley, Bartlett, and Branthwaite, 1980; Bausell and Jenkins, 1977); and finally, the cues must not inhibit or circumvent the desired processing activities (Anderson and Faust, 1967) by forcing extraneous material to compete with essential material or, by permitting non-constructive responses. Research with directive cues in CRT displays has shown cues are most useful in search and recognition tasks (Christ, 1975, 1977).

Other means of changing the format of text to improve comprehension or reading speed have not been as successful as the use of directive cues. These efforts have included breaking the sentence into chunks, hierarchical indentation, and the use of headings.

The goal of chunking research was to facilitate the connections of meanings among words between the nominal stimulus and the reader's schema. A persistent problem of this research was deciding where to break a sentence into thought units. Several implicit assumptions were made. The first was that each sentence was composed of several ideas, each of which was processed in parts by the individual. Second, it was assumed that all readers chunk in the same way. There is no evidence to support either assumption. It appears, then, that ordinary punctuation supplies all the organization necessary within the sentence. When placed in perspective with the number of combinations of format variables available the chunking change was molecular while the intent of text design is wholistic. (See Grabinger, 1984 for a more detailed treatment of chunking research and a list of pertinent references.)

The inability of chunking to have a significant effect on reading speed or learning led to format changes in paragraph organization. The objective of this research was to let the contours of the text format indicate a hierarchical organization of the information within the paragraph or the page. Frase and Schwartz (1979) and Hartley (1980) suggested that the reader's representation (effective stimulus) of the structure of the text may be made more accurate and effecient if the format of the text (nominal stimulus) also represents that structure. Again, the intent was to make the nominal stimulus look like the unseen effective stimulus; however, neither researcher could reject the null hypothesis.

A third format change that did prove to facilitate learning in search and retrieval tasks and comprehension was the use of headings. Headings were useful written in both statement or question forms and whether embedded in the main body of the text or hanging in the margins (Hartley and Trueman, 1982; Holley, 1981).

In sum, the effort to make the nominal stimulus look like an effective stimulus has not seemed successful because there exists no accurate picture of a universal effective stimulus to imitate. It may vary greatly from individual to individual. Plus, given the cyclical nature of perception it would seem reasonable for the effective stimulus to be in a state of constant change and adjustment. It seems that from the application of directive cues and headings that successful format changes are those that facilitate the reading and perceptual cycles. Headings and cues point up specific items of information for additional processing by the learner. The foundation for a set of format rules may be found in the perception and reading processes that will help publication designers construct text that will externally model appropriate cognitive processes, or ". . . allow the learner to activate appropriate methods independently" (Bovy, 1981, p. 208).

Grabinger (1984) attempted to link publication design research to the perceptual processes of individuals by developing models of computer-generated text with several controlled format variables: leading, left and full justification, the presence of directive cues, the use of hypertext, paragraph indication, and heading location. In a multidimensional scaling study using perceptual sentiments expressed by persons viewing models of computer-generated text on CRTs three dimensions describing the perceiver preferences were found: spaciousness, organization, and structure. Spaciousness refers to designs with a lot of white space and openness. Organization refers designs that looked to be grouped or chunked around ideas. Finally, structure refers to designs that appeared hierarchically structured, using hypertext, directive cues, and headings to indicate the structure and location of information.

However, the study used an incomplete cyclical design for the paired-comparison task. Subjects judged 50% of all the possible pairs of the 16 stimuli. This probably contributed to instability and increased stress within the MDS solution. An analysis of a complete stimulus sample may enhance and refine the definitions of the dimensions.

In light of this analysis, this study proposed to identify criteria used by people who view and make perceptual judgements about models of computer-generated text. To improve on the previous study this study used a complete set of carefully constructed stimuli and factor analysis techniques to analyze the resulting data. The goal was to identify criteria used by reader/perceivers to analyze the apparent effectiveness of several models of CRT screens based common text format variables. These criteria (factors or dimensions) can, in turn, be defined and eventually used as general design variables related to the perceptual/reading process rather than small, narrow typographical variables.

Chapter 2

Methodology

Dependent Variable

Print and CRT research have concentrated on single independent variables, usually using reading speed, recognition, or comprehension as dependent variables. This has contributed to the development of standards for individual variables, but not to guidelines for the combination of those variables. The use of a dependent variable based on judgements or sentiments would permit the use of a multivariate statistical technique, such as factor analysis or multidimensional scaling. The main advantage of a multivariate technique, such as the factor analysis technique used in this study, is the ability to examine a multidimensional variable, such as text format perception, with a unidimensional measurement.

In this case, the dependent variable was a unidimensional measure called "study-ability." "Study-ability" was operationally defined as the rating assigned by participants to models of computer-generated text based on the perceived ease with which a text model could be read and studied as if the model were actual text.

These ratings were then submitted to a Q-mode factor analysis to identify the underlying criteria that were used when the perceiver formed a judgment related to the "study-ability" of a text model.

Research Questions

A series of questions were used as a guide for interpreting the factor analysis data. The fundamental assumption was that some underlying factors, smaller in number than the original set of variables, was responsible for the covariation in the variables. Therefore, a prerequisite for the analysis was that the unidimensional scaling of stimuli represent a multivariate space, leading to the question:

1. Can the multivariate concept of computer-generated text design be scaled by readers on a unidimensional scale ?

After the validity of using factor analysis was established by the presence of significant factor loadings the factors or dimensions were named and conclusions about their attributes drawn. The following questions served as a guide for the process:

2. How many factors or dimensions represent the judgements expressed by the participants?

3. What are the definitions of the dimensions?

4. What implications do the dimensions have for design of computer-generated text presented on CRTs?

Data Gathering Method

Sample

The sample was composed of 31 undergraduate student volunteers from the University of Nebraska--Lincoln Teachers College. Participants were United States citizens between the ages of 20 and 25.

Stimuli

Stimuli were 64 models of computer text (see Appendix A) designed to use variables that have been researched in both print and CRT legibility research and that are frequently used in text design. A method called notation (Twyman, 1981) was used to design the text models. This method prevents contamination from content variables by using "X"s, "O"s, and "I"s to represent written text. The "X" is the basic graphic unit that stands for typographic norm such as the bulk of the copy on a page. The "O" represents a primary variation from the typographic norm including italics, all upper case, bold type, color, headings, or reverse type. The "I" is a tertiary graphic unit used rarely to represent something particularly unique in style. The major benefit of the notation method

> is that it encourages serious thinking about typographic problems in conceptual terms, and independently of problems associated with particular copy or composition systems. (p. 11)

Twyman's standard method was altered slightly in this study. Grabinger (1984) used the standard method of placing "X"s to represent the body of the text without indicating any spaces between words. Spaces were used in this study to make groups of "X"s look more like words in actual text. Comments by participants in the 1984 Grabinger study indicated that the solid block of "X"s may have looked too orderly and unrealistic. The placing of the spaces was determined by taking a piece of actual newspaper text and copying it using only "X"s and spaces.

The stimuli were designed to reflect combinations of six format variables used frequently in publication design (see Table 1): leading, directive cues, paragraph indications, hypertext, position of headings, and line length.

Table 1

Variables Used in Stimuli Design

Leading:	(SS)	single spacing
	(DS)	double spacing
Directive Cues:	(NDC)	no directive cues present
	(DC)	directive cues present
Paragraph Indication:	(IP)	indented paragraph
	(SP)	spaced paragraph
Hypertext:	(NHT)	no hypertext present
	(HT)	hypertext present
Heading Position:	(EH)	embedded headings
	(IH)	isolated headings
Line Length:	(LL)	long (60 character) line
	(SL)	short (40 character) line

Leading (space between lines of text) had two values: single spacing (SS) and double spacing (DS). Kolers, Duchincky, and Ferguson (1981) found that double spacing between lines of text on a CRT marginally increased reading speed over single spacing. However, they also found that reading single spaced text required less occular effort, because more densely packed text requires smaller and fewer eye muscle movements. Grabinger (1984) found that perceivers preferred double spaced text. However, this preference is not clear cut and interacts with line length. Readers often do not mind short lines of single-spaced text (Tinker, 1962). Therefore, the affect of single vs. double spaced text was tested with both short and long lines.

Line length was another variable. Turnbull and Baird (1964) recommend that lines of text be between one alphabet and two and one-half alphabets long. In other words, a line should be about 26 to 65 characters long for a given style and size. Research by Keenan (1981) supports this. Keenan used a computer to determine the optimal line length in terms of "chunks" (meaningful phrase units for different readability levels. Results indicated that line lengths in the vicinity of 45 to 55 characters best maintain the integrity of the greatest number of idea units. Yet, despite this research designers often persist in long lines of text. Text presented on the CRT screen can be made up to 80 characters long. Therefore, the two conditions in this study were set at 60 (LL) and 40 (SL) character lines. Both fall within acceptable standards, yet are easily discriminated from one another.

Directive cues took on two values: either the cues were present (DC) or not present (NDC). Grabinger (1984) found that the presence or absence of directive cues had no affect on preferences expressed by participants. However, directive cues have proved a useful format device when used sparingly and related to desired outcomes. Therefore, cues were added to the stimuli by shading three selected "words" with lines.

Paragraph indication was a fourth variable. Paragraphs were indicated by the use of increased white space (SP) (double or triple spacing between paragraphs) or traditional indentation (IP). Subjects in the Grabinger 1984 study stated that they preferred the increased space method of paragraph indication because, the screen appeared more structured and organized.

Hypertext was a fifth variable indicated by its presence (HT) or its absence (NHT). Heinen (1984) recommends the use of hypertext to help keep readers apprised of their location in a lesson, the lesson content, their progress, and essential computer commands (e.g., forward, back, or exit). Hypertext is recommended because CRT text pages are short, change frequently, and the nature of a CAI lesson often prevents easily flipping ahead or backward.

Heading location was the sixth variable used. Headings were either embedded in the text (EH) or isolated in a separate column (IH). The use of headings, particularly in question form, has facilitated learning (Hartley and Trueman, 1982). The location of the headings may affect the appearance of organization and structure of the page (Grabinger, 1984).

The 2 X 2 X 2 X 2 X 2 X 2 design presented 64 possible stimulus screen design combinations. Each page was designed on an IBM PC computer with the Multimate word processor program. The stimuli pages were printed on a dot-matrix printer and then enlarged on a photocopy machine. The enlarged copies more closely resembled the size of a typical CRT screen. After enlargement the stimuli were laminated for durability.

Procedures

1. Subjects were welcomed to the experiment and asked to sit in a chair at a table.
2. The instructions for the procedure (see Appendix D) were then played on a cassette recorder and any questions were answered.

3. Subjects then performed the Q-Sort procedure. They were asked to sort the stimuli into seven piles according to the "study-ability" factor described in the instructions. Four stimuli were placed in Pile 1, 8 in Pile 2, 12 in Pile 3, 16 in Pile 4, 12 in Pile 5, 8 in Pile 6, and 4 in Pile 7. This arrangement approximated a normal distribution. The Grabinger (1984) study found that only a few of the sixteen stimuli used elicited strong feelings, while most were of neutral nature. This study, then assumed that the complete set of stimuli would approximate a normal distribution, with few eliciting strong feelings.
4. After completion of the sorting task the participant was interviewed about the criteria used during the task. Responses were written down by the experimenter. Participants were shown the first pile and asked, "Why did you rate these the highest on the "study-ability" factor?" Then, they were shown their seventh pile and asked, "Why did you rate these the lowest?"

Chapter 3

Results

The experiment produced one group of data which was analyzed by factor analysis techniques and a six-way analysis of variance. The factor analysis produced three significant dimensions or factors labled spaciousness, structure, and simplicity. The results of the ANOVA were used to help interpret the meaning of the factors discovered in the factor analysis.

Data Analysis Procedures

The factor analysis procedures used were alpha factoring techniques from SPSSX (SPSSX, 1983) for a Q-mode factor analysis. The analysis proceeded in 4 stages:

First, a data file was prepared for the alpha factor analysis and the ANOVA. A 31 X 64 cell data matrix of subject ratings of each stimulus, with the stimuli assigned to rows was prepared for the factor analysis. A second matrix with the subjects assigned to rows was developed for a repeated measures ANOVA.

Second, the alpha factor analysis was performed with Varimax rotation. Alpha factor analysis was chosen because it maximizes the similarity among similar thinking subjects (Nie, et. al, 1975).

Third, a factor array procedure using a computer program written by Kramer and Amedeo (1984) was performed using the factor loadings from each subset of subjects that load highly on each main factor. This procedure transformed the raw scores of the stimuli to scores representing the magnitude of the factor loadings for subjects loading highly on that factor. The transformed scores of the stimuli were then used to sort the stimuli according the same scale used by the subjects initially.

Fourth, a six-way, repeated measures analysis of variance was performed on the data using the BMDP (1981) statistical package. Data from the ANOVA were used to aid in the interpretation of the dimensions.

This design provided output that permited discussion about the following:

1. The Q-mode factor analysis yields actual groups of similar thinking individuals;
2. the factor array procedures provide a Q-sort, or perception, of the stimuli associated with every significant factor derived from the factor analysis;
3. a comparison of different group perceptions based on the differences in the factor arrays, or, in effect, differences in the perceptions of the model text designs;
4. and, a picture of the importance of the variables via the analysis of variance.

Factor Analysis Solution

The data matrix submitted for analysis contained the pile number in which each subject placed the specific stimulus. The alpha analysis calculated a correlation matrix between all pairs of subject-sorts and then performed a Q-mode factor analysis to extract groups containing subjects that covaried because of similar Q-sorts (see Table 2). The Q-mode factor analysis is designed to isolate distinctive groups, if such groups exist. Since every Q-sort represented a "study-ability" value perception over the 64 text models, a covariance of Q-sorts is a covariance of similar perceptions. Each significant Q-mode factor should, then, represent a prototypical "study-ability" perception, reflecting the common but not the unique portions of the perceptions of those subjects who load highly on it.

The results of the rotated factor analysis are presented in Table 2 (next page). Significant factors selected for analysis were Factors 1, 2, and 3. Factors 4, 5, and 6 were not considered significant because of the small number of subjects loading significantly (more than .5 variance) on those factors.

Factor Array Procedure

To define the factors it was necessary to take the additional step of creating factor arrays for each Q-mode factor derived in the analysis and considered to be significant. Taking this additional step permitted the discussion of the distinctive types of text design perceptions that potentially exist in the population.

The process of arriving at a Q-sort for a factor or group is analogous to a subject's task of mentally assigning values to text models and then discriminating among the valued text models by sorting. The result is a group Q-sort instead of a single subject

Table 2

Rotated (Varimax) Factor Matrix (>.5 Variance)

Subjects	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
22	.90289					
25	.88960					
1	.82311					
18	.80017					
20	.77836					
24	.73605			.55087		
17	.70320					
5	.69826					
26	-.61377					
15	-.58523					
14	.55164		.52254			
30	.50821					
31		.81175				
3		.77916				
8		.68400				
10		.66538				
27		.58084				
2		.56860				
16			.80607			
11			.76487			
13			.60475			
21			.52238			
9				.72889		
12				.62299		
23			.57278	.57884		
6					.93605	
4					-.53106	
19					.51031	
7						.63307
28						.60481
29						.58716

Table 3

Factor Arrays

Factor 1

1	2	3	4	5	6	7
2 17 20 21	5 6 8 10	1 7 12 14	4 13 16 23	3 9 32 36	11 25 27 35	43 51 59 63
	19 22 26 50	15 18 24 28	29 31 33 37	42 44 46 47	41 45 57 64	
		30 34 40 52	38 39 53 54	48 49 60 61		
			55 56 58 62			

Factor 2

1	2	3	4	5	6	7
1 37 39 47	3 6 15 17	5 12 13 14	4 8 10 11	7 22 27 32	2 9 25 34	16 23 49 57
	18 26 36 62	21 28 30 38	19 20 24 29	40 44 48 50	35 45 52 58	
		41 46 53 64	31 33 42 43	54 60 61 63		
			51 55 56 59			

Factor 3

1	2	3	4	5	6	7
13 38 41 53	1 3 5 18	2 4 12 14	6 8 10 11	9 16 17 22	7 32 43 48	27 34 35 50
	19 26 28 46	20 21 37 39	15 24 25 29	23 31 36 40	55 57 58 63	
		45 47 52 62	30 33 44 51	42 49 60 61		
			54 56 59 64			

Table 4

Repeated Measures Analysis of Variance

Main Effects ($p < .01$)

Source	Sum of Squares	Degrees of Freedom	Mean Square	F
Mean	31720.00454	1	31720.00454	6992498.00
Error	.13609	30	.00454	
Hypertext	373.64970	1	373.64970	21.42*
Error	523.30343	30	17.44345	
Headings	.84728	1	.84728	.07
Error	347.66835	30	11.58894	
Directive Cues	236.50454	1	236.50454	15.28*
Error	464.44859	30	15.48162	
Spacing	64.23841	1	64.23841	4.50
Error	428.65222	30	14.28841	
Line Length	237.88760	1	237.88760	27.55*
Error	259.00302	30	8.63343	
Paragraph	136.81502	1	136.81502	18.82*
Error	218.13810	30	7.27127	

*$p < .01$

sort using high-loading individuals. Thus, the calculation of the factor's perceived "study-ability" values for all of the text models depends on the prior scores assigned to text models by these high-loading individuals. The factor arrays are presented in Table 3.

ANOVA

The six-way repeated measures analysis of variance was performed to help shed light on the factor anlysis information. The ANOVA presented differences among four of the six main effects: hypertext, directive cues, line length, and paragraph spacing (see Table 4). CRT screen models with hypertext, directive cues, short lines and, spaced paragraphs were rated higher than models without hypertext or directive cues and with long lines and indented paragraphs.

Factor Definitions

Factor 1. Ten participants had high loadings on this factor, or ten participants used similar criteria when sorting the 64 text models. On the basis of the sorted stimuli, subject interviews, and ANOVA this factor is labled structure. The preferred stimuli appeared more structured, that is, organized and hierarchically arranged than the low rated stimuli. The four highly rated stimuli (Group 1) had hypertext while the four low rated stimuli (Group 7) did not have (see Appendix A for the Group 1 and Group 7 stimuli in each of the three factors). This is consistent with information in the ANOVA where the hypertext condition was rated higher than the no-hypertext condition. Also, all four of the high rated models had the directive cues option, while three of the low rated models did not have directive cues. This also, is consistent with the ANOVA results. The paragraph condition may have contributed to the appearance of structure, too. Three of the highly rated models were the spaced paragraph condition, while all four of the low rated stimuli were the indented paragraph condition. The condition of structure suggests that the high rated stimuli appear organized with clearly marked segments of information, yet related to a major topic.

Factor 2. The highly rated stimuli in Group 1, sorted on Factor 2 seem to be characterized by their simplicity. Three of the top four are double spaced with no complexities introduced from the presence of hypertext, isolated headings, or spaced paragraphs. All appear easy to read from top to bottom and more unified for a simple reading task. The four models from Group 7 are made more complex and less unified by the use of hypertext, isolated headings, or both.

These four stimuli lack the appearance of structure described in Factor 1 and also appear scattered and less easy to read. Simplicity of design was a significant criteria for six subjects who loaded highly on Factor 2.

Factor 3. The distinguishing characteristic between the stimuli in Group 1 and Group 7 seems to be spaciousness for the six subjects who loaded highly on factor 3. Three of the four highly rated stimuli are double spaced with short lines, while all four of the lowly rated stimuli are single spaced and appear jammed-up with text. Although the ANOVA indicated no main effect difference between the single and double spaced models as a whole, this subgroup of participants thought that this was important. This is consistent with subject interviews where 5 of the subjects stated that their main criteria was double spacing within the text.

Chapter 4

Discussion

The use of multivariate techniques in text design and visual problems can provide a great deal of data (see also Grabinger, 1984 and McIsaac, Mosley, and Story, 1984). The value of such techniques derives from the emphasis on the identification of perceptions rather than on the affects of individual text design variables. By the very nature of perception the human being is adaptive. Humans can read easily a wide variety of type styles, type sizes, line lengths, and graphic combinations. Difficulties in reading, searching, or comprehension tasks occur at extremes, such as very small or very large type size, suggesting that there are many combinations of text design variables that may be considered optimal. Techniques such as factor analysis and multidimensional scaling provide a basis for identifying perceptual tendencies or patterns that suggest gidelines for the combinations of text design variables.

The original problem of this study was to identify perceptual judgements expressed by persons viewing models of computer-generated text. The combinations of six CRT design variables, each with two values, seemed to affect three criteria used by participants in making judgements: structure, simplicity, and spaciousness. While conscious of such things as the presence or absence of directive cues, the length of the lines, and double or single spacing, the participants were guided in their judgements by the overall structure, simplicity, and spaciousness of the documents.

The first criteria discussed was structure. This dimension was also found in the 1988 multidimensional scaling study (Grabinger). Structure refers to designs that indicate a hierarchical arrangement of subject material organized with the use of hypertext, isolated headings, spaced paragraphs, and directive cues. Participants stated that they would prefer to study from text that appears chunked into manageable and organized segments.

The second criteria was the simplicity of a design. If the design did not appear neatly structured the participants preferred a design with few complications. It would seem to suggest that if the design does not appear structured around its subject matter the reader would prefer simple lines of text. No structure would be better than a messy or busy screen.

The third criteria was spaciousness. While a careful and neat structure can utilize single spaced type and long lines, lack of structure will cause a screen design with single spaced type and long lines to be rejected. Yet, given lack of structure, then double spacing is an important criteria. A screen of information should be double spaced, preferably with short (45 character) lines if no other graphic or design features are used to help break the text into manageable chunks of information.

While the use of mulitivariate techniques offer greater sophistication in the exploration of complext topics such as text design, they also require a great deal of data collection. Although this study remedied a fault of a previous study by the use of a complete stimulus sample, there was still the need for more information. A content analysis of participant descriptions of the stimuli as well as an adjective rating of the stimuli could facilitate interpretation of the factors. While two of the factors (structure and spaciousness) were consistent with the factors discovered in the 1984 Grabinger study, one of the factors was different. In the 1984 study the third factor was described as organization, whereas in this study the factor was described as simplicity. It is conceivable that neither is an accurate description and a similar study using adjective scales, content analysis, and structured interviews may help clarify or eliminate that dimension.

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Appendix A

Stimuli

Factor 1: Structure

Group 1

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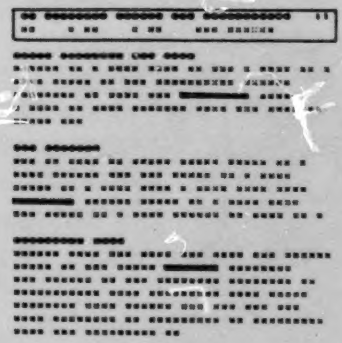
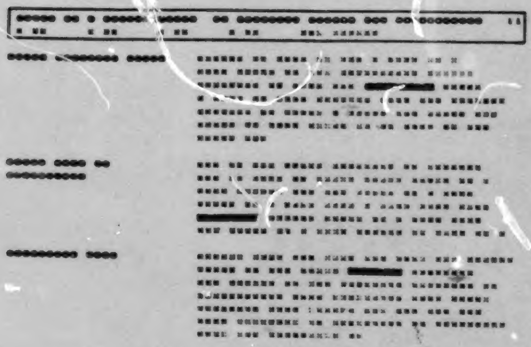


17



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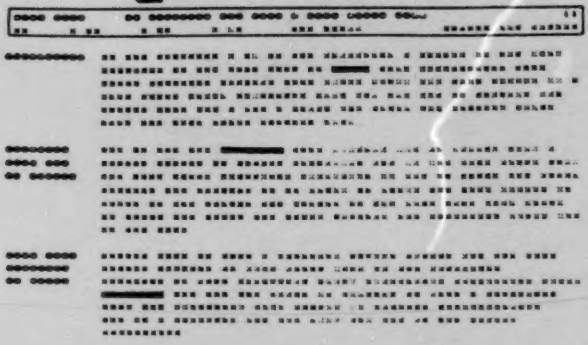

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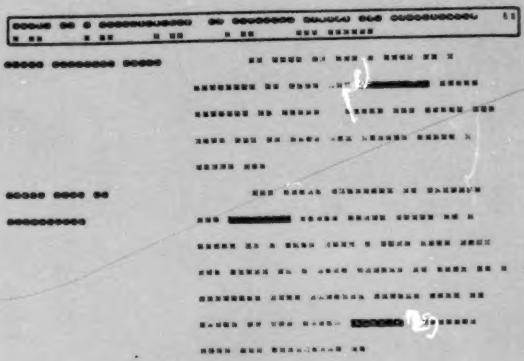

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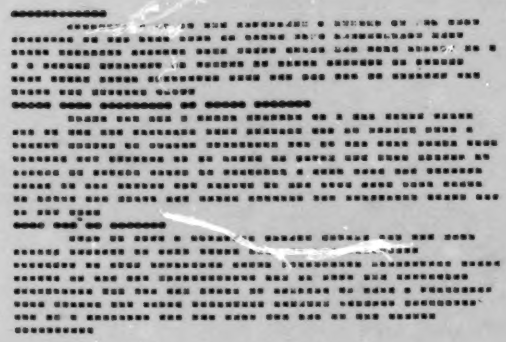
Factor 1: Structure

Group 7

43



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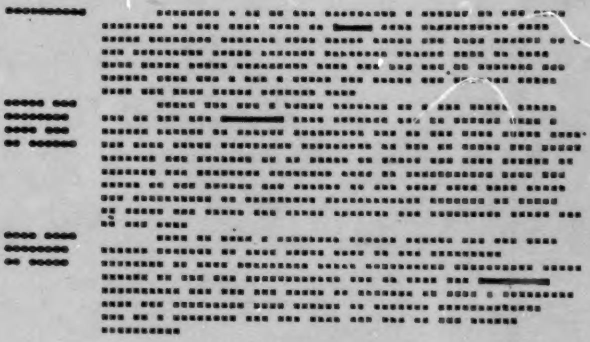

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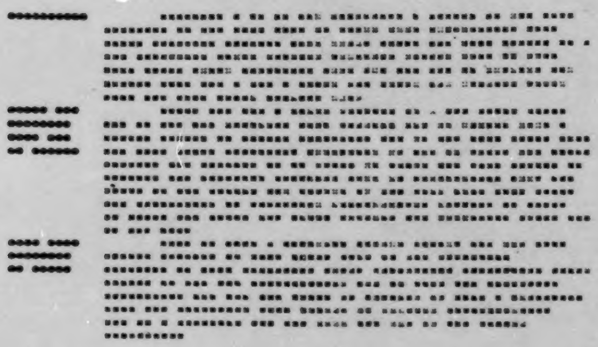

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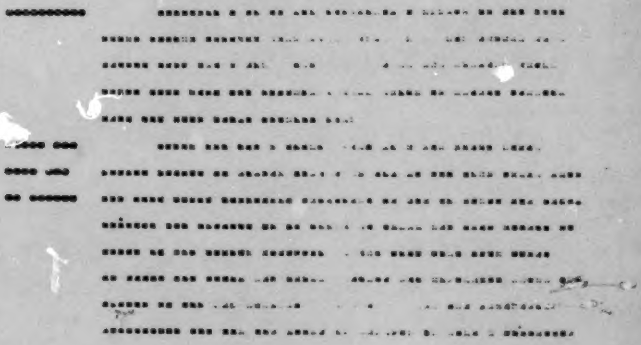

Factor 2: Simplicity

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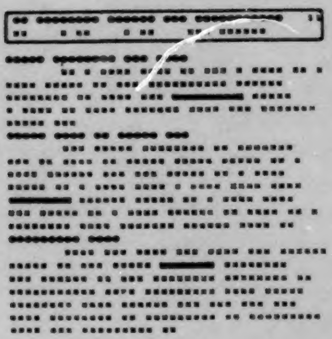
Group 1

1



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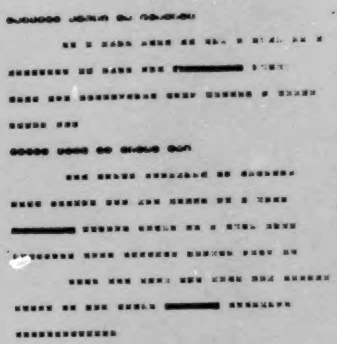

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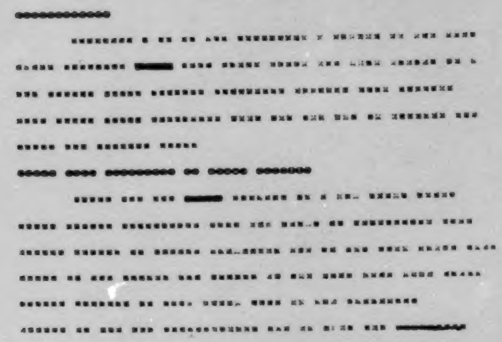

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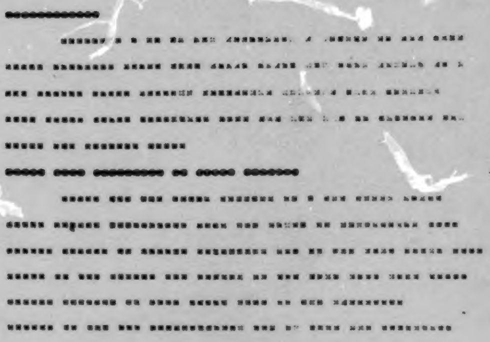

Factor 2: Simplicity

Group 7

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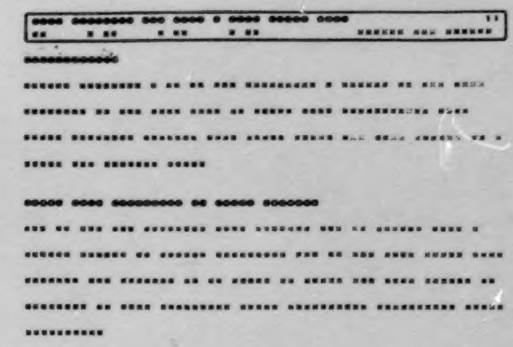
16



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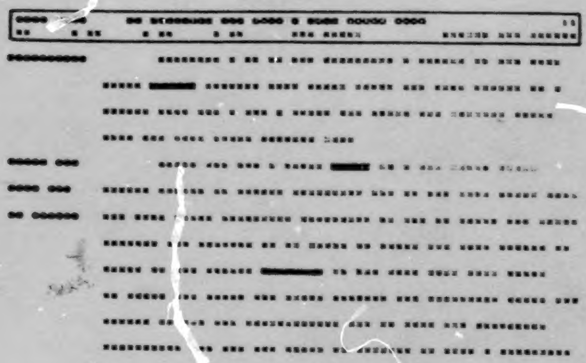

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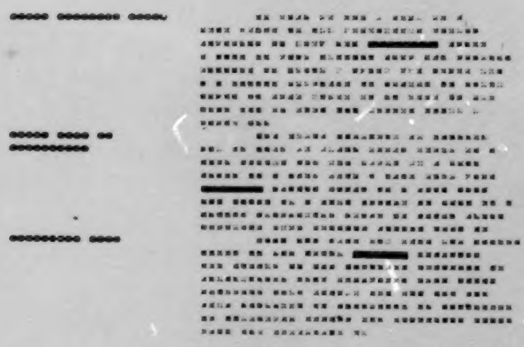

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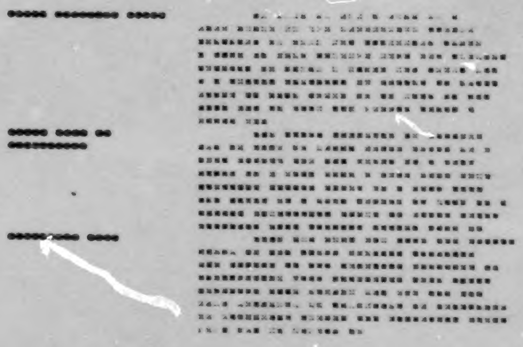

Factor 3: Spaciousness

Group 1

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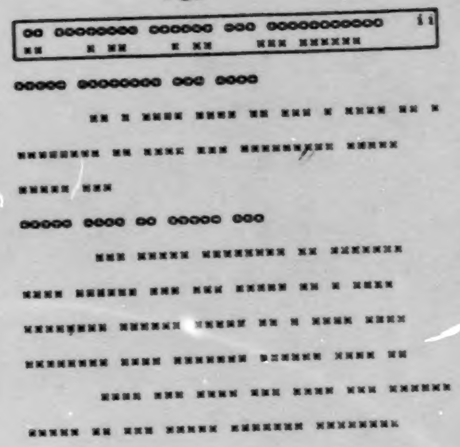
13



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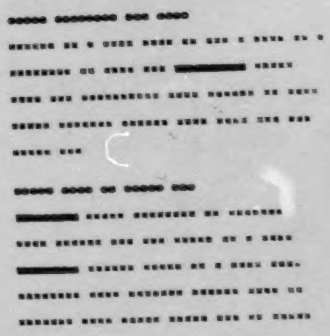

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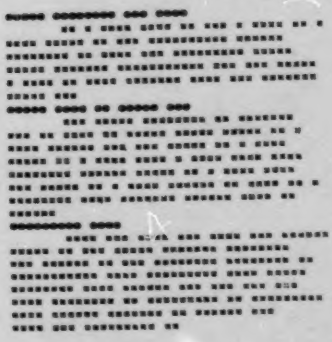

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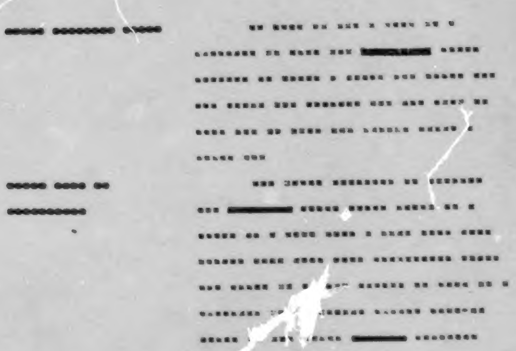

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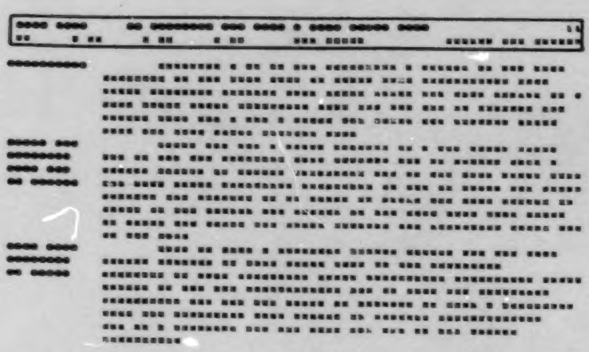
Factor 3: Spaciousness

Group 7

27



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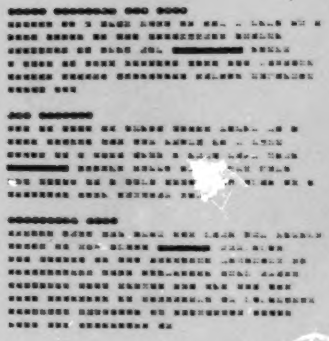

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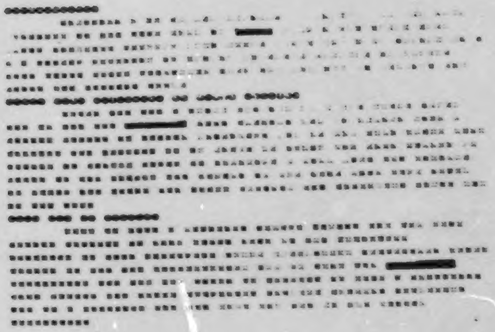

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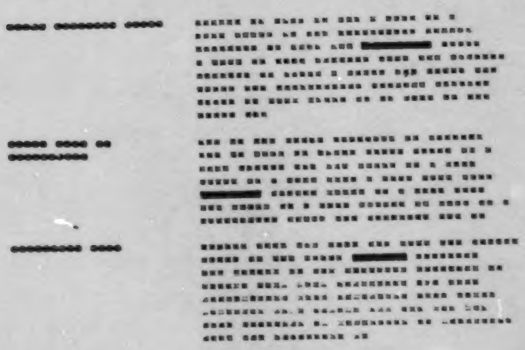

Appendix B
Instructions to Subjects

You will examine several models of computer-generated text. These are models of text that may be seen on computer television screens when using computer-assisted instruction.

Before you begin, look at some of the text models in front of you. Note that they are composed of "X"s and "O"s. The "X"s represent the body of the text. The "O"s represent words that are special, such as headings or subheadings. On some of the models you will see three sets of "X"s that are darker than the rest of the text. These dark sets of "X"s represent words that may be in italics, bold type, or underlined. Finally, some of the models have a box at the top of the page. This box is called hypertext and contains a summary of the content of the lesson and a list of computer commands that may help the learner during the lesson.

When you examine the text models evaluate each model on a factor called "study-ability." "Study-ability" refers to both readability and learning characteristics. For example, a text model with a high "study-ability" factor would appear easy to read and easy to study. On the other hand, a text model with a low "study-ability" factor would appear hard to read and hard to study. You are the judge of what appears easy or hard to read and study. There is no right or wrong answer. The best answer is whatever you decide. Look at each model and ask yourself, "If this were actual text would I find this style easy to read and study or hard to read and study?"

Sort the 64 models of computer-generated text into seven piles according to the "study-ability" factor. Remember to base your judgements on how easy the model appears to study as if the model were actual text. Use the sorting procedure described as follows:

In Pile No. 1, place the 4 text models that have the highest "study-ability" factor. In Pile No. 7, place the 4 text models that have the lowest "study-ability" factor. One way to do this is to go through the text models sorting them into high, medium, and low "study-ability" piles. Then return to the "high" pile and find the four with the highest "study-ability" rating and place them in Pile No. 1. Then, go to the "low" pile and find the four with the lowest "study-ability" rating and place them in Pile No. 7.

After placing models in pile numbers 1 and 7 there will be 56 models left. Place all of the models together and repeat the sorting procedure. Place the 8 with the highest "study-ability" rating in Pile No. 2 and the 8 with the lowest "study-ability" rating in Pile No. 6.

Then there will be 40 text models remaining. Place all of the models together again and re-sort them. From these 40 models place the 12 with highest "study-ability" rating in Pile No. 3 and the 12 with lowest rating in Pile No. 5.

There will then be 16 models left and they are all placed in Pile No. 4.

The number of the text models to be placed in each pile also appears on the pile identification cards on the table in front of you. you may rearrange the models until you are satisfied with their placement, but make sure you place the specified number of text models in each pile.

you may refer to these instructions or ask the experimenter for help whenever you wish. Finally, remember to judge each model on how easy it appears to study as if it were actual text.

Drill Sargent or Math Teacher
Teacher Socialization and Computer Advertisements

Mary Gribble
Diane Gamsky
Robert Muffoletto PhD.

This theoretical paper addresses the question of teacher socialization through contrived images; more precisely, the influence of advertising as part of an educational and socialization process. It will examine how computer advertisements directed towards teachers influence their perceptions of how computers can and should be used, and how the same advertisements help dictate the types of computer instruction in use in the schools today.

The goal of advertising is to motivate behavior--to sell a product, service or idea. To accomplish these goals it is important to have an understanding of the psychological and social forces that influence human behavior. This paper focuses on the consideration of these forces in conjuction with advertising's deliberate image-making with the intent to sell.

Teachers must make rational choices concerning the use of computers, (or the decision not to use them). "Most researchers would agree that consumers (in this case teachers) use advertising as a prime source of information and that they use it as a time-saving way to help them make product decisions." (Holtje, 1978) With this in mind, computer companies go to great lengths to supply teachers/consumers with the best attention getting ads and sales campaigns with the intent to sell their products. It is in this way that computer advertising plays a crucial role in the dissemination of information, and thus helps teachers make rational choices about the product they wish to purchase.

The institutional definition of advertising is: "The presentation and promotion of ideas, goods, or services by an identified sponsor. At one time, manufacturers would develop products and then try to sell them; it was a cart-before-the-horse situation, in which the needs of the consumers were seldom considered. ...Modern marketing is consumer-oriented." (Holtje, 1978) Today, the target group, defines WHAT is to be said, HOW it is to be said, WHEN it is to be said, and WHO is to say it, by making their needs publically known. (Kolter, 1982) Advertisers base their advertising strategies upon these critical facts. In other words, once the target group and their needs are identified, the advertiser can develop the message so their products appear to meet a perceived need of the consumer. The extent to which a company can present itself and the product, (computers) in relation to the target audience needs, advertising can be successful.

The message of advertisements is designed to fulfill a need. The message content is also designed with a particular appeal, theme, idea or unique selling proposition often linked to psychological considerations of the target group. It may be a rational, emotional or moral appeal. Rational appeals are directed to the rational self-interest of the audience. Emotional appeals stir up positive or negative emotion that will motivate product interest or purchase. Moral appeals deal with the issue of right and wrong.

Advertising may also be looked at from a sociological standpoint, as pointed out by Goffman. According to Goffman in the book Gender Advertisements "the task of the advertiser is to favorably dispose viewers to his product, his means, and by and large, to show a sparkling version of that product in the context of glamouous events." One can interpret this statement to mean that the job of the advertisers is two-fold. First, to present his product favorably and sell it, and second, to communicate to the viewer social implications of buying a product or an idea. An_implication_of_this_is_that_if you_buy_the_product,_you_are_probably_apt_to_buy_the_other_ideas_being communicated_in_that_advertisement. John Berger in Ways_of_Seeing states that, "publicity (advertising) adds up to a kind of philosophical system. It explains everything in its own terms. It interprets the world."

Interestingly, Goffman notes that the advertiser transforms "opague goings on" into "readable form". This means that advertisements take advantage of unclear, unconcise thoughts and ideas and gives them structure and encoded meaning, thereby increasing the chances that the viewer will purchase their product. He goes on to say that, "it is the inclination of individuals and society to fall back from a conscious struggle to understand ourselves and learn about ourselves at a remove, and to accept as real an almost wholly unassumed self." (Goffman 1976) This can be interpreted as meaning individuals have a tendency to view advertisements and accept a pictorial staged representation, as being real life, thus causing them to accept what they see at face value rather than view the advertisements with a critical eye.

Knowledge of what microcomputers can and cannot do is needed for rational decisions by educational leaders.(Judd 1984) Therefore, it is logical to assume teachers will seek out information which will enable them to make those decisions. This coupled with the fast pace of this technological industry encourages teachers to look to ads for educational purposes. Advertisers also realize the need for an educational approach to the introduction and exhibition of their product to suit their target market. Together it creates a marketing strategy based upon an educational format.

The photographs examined in this paper fit the criteria for being considered educational photographs as discussed in the previous parpagraph -- that they seek to inform the educators seeking information about the product. It is our hypothesis that advertisements do in reality teach, and teachers who view microcomputer advertisements learn about microcomputers.

But to what extent do teachers also learn about educational issues surrounding computers? Are social messages embedded in those advertisements?

Judith Williamson notes that "Advertising gives goods a social meaning. Material things we need are made to represent other non-material things we need; the point of exchange is where meaning is created." (Williamson 1978) Goffman (1976) more specifically points out the nature of embedded signals when pictures are arranged, rigged, or set up, implying that scenes real enough in their own right are brought to induce radically wrong inferences. Staging the scene results in pictures of covertly contrived displays; the picture appears realistic, but is not reality. It follows that convertly contrived messages could influence a variety of decisions made by teachers regarding computers; including the purchase of hardware, software, integration of computers into the curriculum, the role of computers in education, and methods of assimilation and use of the computer in the schools and individual classrooms.

It is because of these "covert messages" embedded in advertising that it's necessary to scrutinize advertisements with a critical eye. One must understand what they signify and the potential effect on teacher's perceptions of computers. It is like the "hidden curriculum" of advertising. As part of critical evaluation of advertising one must consider: what is the message, whose message it is, and what is the message's effect on the viewer. (Muffoletto, 1984)

The model used in examing the two advertisements chosen for this paper was developed by Robert Muffoletto PhD. In his model he describes three elements in a photograph which interact with the viewers sum total experience giving the viewer meaning. The elements discussed are; relationship, prop and gesture.

Relationship is concerned with the spatial positioning of objects in the picture. The relationships may be thought of in terms of large/small, infront/behind, above/below, apart/together and so on. The pictorial representations of these relationships creates a psychological relationship. For example, Gaufman in Gender Advertisements points out that a man positioned higher then a woman in a photograph symbolizes the man's high social place or dominance.

The camera angle used to shoot the picture will also affect the relationship. Monaco (1981) points outs "That high-angle shots dimminish the importance of the subject, while low-angle shots emphasize its power. For example, a picture shot from a high angle will cause the viewer to feel like they're looking down on a situation from a positon of power. (Muffoletto, 1984)

Props are objects within the picture. They may be fully contained in a frame or may extend beyond a frame. Props themselves may include people, clothing, handled and unhandled objects. These objects constitute the content of the picture. The interaction of the elements in the frame create the meaning. For instance, similar to the use of "frame" in film, when the photographer choses to depict action which extends outside the confinds of the actual picture area, the form is considered to be "open". In an open form the viewer is subliminally aware of the action which extends beyond the defined area of the frame. If the image of the frame is to be considered self-sufficient, then the form is considered a 'closed form'.(Monaco, 1981)

Gesture is the third category and it refers to the action of props towards other props. Typical gestures include: reaching, touching, looking, pointing, standing and walking. Meaning is derived when the viewer looks at the props, and how the gestures are directed.(Muffoletto,1984)

The three codes of relationship, prop and gesture interact together to form the image to be decoded by the reader. It is in the analysis of the juxtaposition of these three codes that allows the signification of the image to be deconstructed and them reconstructed by the viewer into another encoded message (Hall 1982). It is important to note that the viewer may decode a message which differs from the intended message. The message decoded depends on the individuals' meaning given to the three seperate codes in the picture.

Two ads were chosen as examples of how the model would be used to analyze messages encoded in ads. Both ads appeared in the magazine Classroom Computing .

The first is an advertisement for an APPLE Computer System, called the "School Bus". The elements the picture include:

Props
- a woman teacher
- three male students
- three female students
- minorities are included among students
- seven APPLE computers, and monitors
- books on the teachers' and students' desks
- paper and pencils on desks

- hair brush
- two tote bags
- one WALKMAN

Key_Words

- efficient
- control
- communicate
- teacher effectiveness

Relationship:

The relationship between the students and the teacher is defined by the arrows going out from the teacher's desk to each student, and back to the teacher.

Gestures:

Students and the teacher are all reaching out toward the computer, touching keyboards. Their attention is directed towards the monitors.

The messages contained in this ad are numerous. The obvious one is to buy the "school bus" system to manage your classroom. The other embedded messages could be interpreted as:

- how to set up a structured computer classroom
- instruction can be managed efficeintly using a comprehensive system
- the system will enhance classroom control
- the system will increae student productivity
- the system will fit in with existing curriculum
- computers can be easily accessed by both teachers and students
- instruction can be individualized
- teachers can manage instruction easily via computers
- all students can learn computing
- the system will help teachers be accountable for student work
- students can learn academic basics and computing at the same time
- communication between students and teachers can increase
- communication between students is decreased
- both students and teachers "like" working with computers

The second advertisement is for educational materials designed by the FISHER SCIENTIFIC COMPANY. The ad takes a futuristic approach in marketing a computer called the "S+".

Props:

- one teacher
- six visible students; 3 male, 3 female
- two partially visible students;
  the open frame indicating additional students in the room
- eight computer terminals
- eight different pages of text on the screens
- clean desk tops
- glimmering lights

Key Words

- unlock imaginations
- awesome responsibility
- tomorrow
- limitation-free

Relationship

The relationship between the teacher and students is shown by the teacher hovering over the student and the computer monitor. There is no relationship indicated between the students.

Gestures

The teacher is gesturing towards the student and computer by leaning, showing acceptance and direction. The students only gestures are towards the keyboard and monitor. They are touching the keyboard and looking only at the monitor.

The main message in this ad is to purchase a computer system to manage instruction. The other covert messages may be interpreted as:

- computer education is the "wave of the future"
- students' futures will be enhanced by knowing computer programming
- education can exist independently of traditional curriculum
- all courses can be taught via computer
- teachers manage instruction
- instruction can be individualized
- students will stay "on task"
- behavior management will be simplified
- teachers can learn programming
- students can and should learn programming
- interactions between students is minimized while interaction between teachers and students is maximized.

The two advertisements examined support the notion that teachers need machines to make the learning situation better. They propose that the integation of computers into the classroom will improve the education which students are currently receiving. They do this by stressing pertinent educational issues such as individualized instruction, classroom structure, individually paced instruction, behavior management and the productive use of classroom time.

In conclusion

Teachers are under a great deal of pressure to integrate computers into the curriculum. Computer companies recognizing this need, target this audience (teachers) and run advertisements which suggest that the need to incorporate computers into the curriculum is great. The advertisers through the use of varied appeals indicate that educational needs can be met through the purchase of computers and commercially designed software.

However, these advertisements have psychological as well as sociological impact. They contain educational and visual messages which cue teachers to take in the overt and covert information contained in the ads and decode that information. Through contrived use of the three codes, relationship, prop, and gesture, an image is created which is not necessarily a representation of reality. Furthermore, the juxtaposition of the elements in the ad may lead the viewer to decode messages other than the "product selling" aspect of the advertisement. These "embedded" messages tie-in with the existing perceptions regarding the use of computers in the curriculum. An example of this would be the perceived suggestion that incorporating computers into the curriculum will improve the quality of education and offer an improved alternative over what already exists. Therefore the "hidden curriculum" of computer advertisements has a direct effect on the teacher's perception of the evolving classroom environment.

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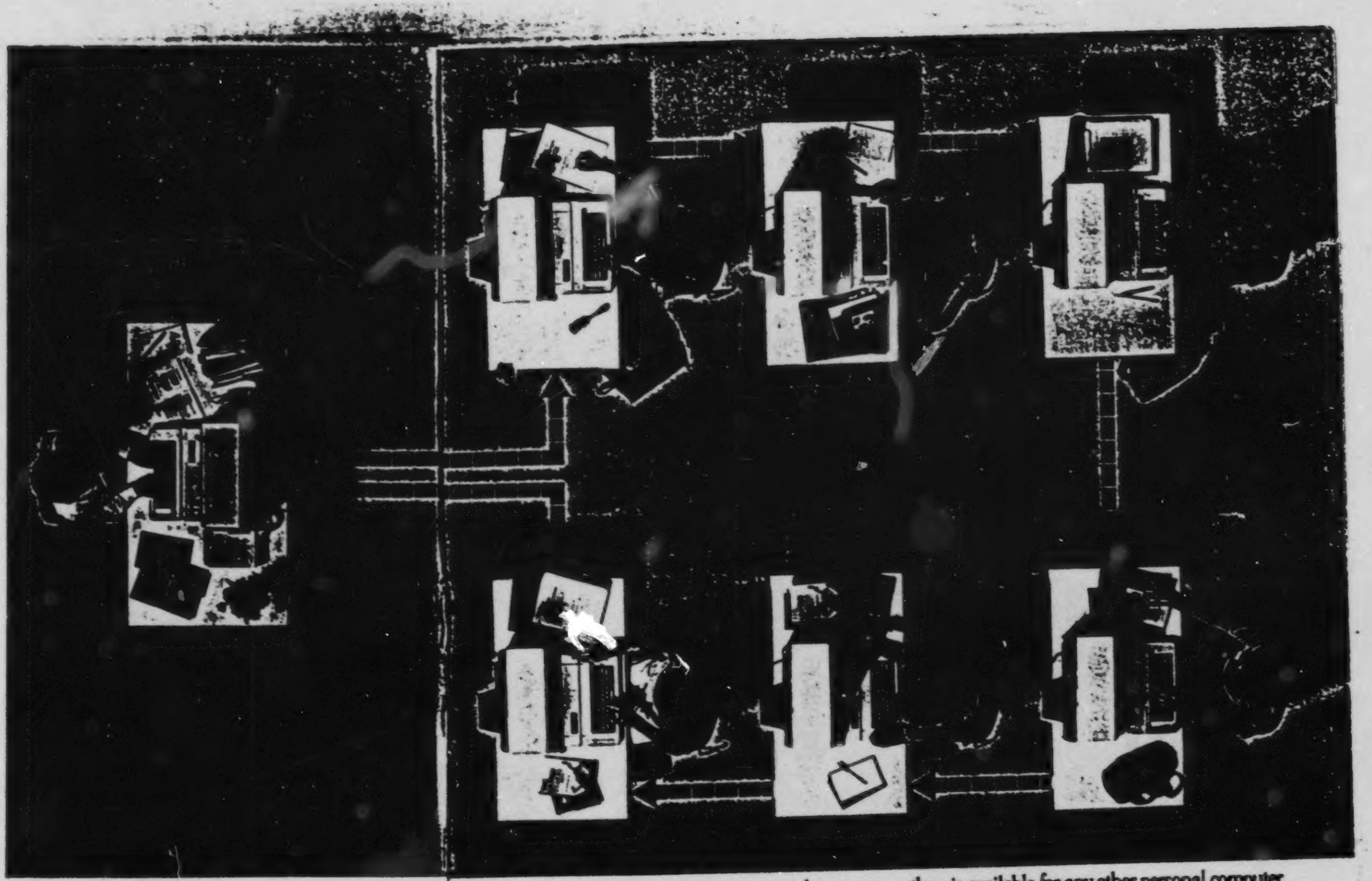
Now Apple makes it easy to become attached to your students.



Introducing the Apple® SchoolBus™ network.

A complete cable, interface, and software package that connects your teacher's station to as many as 30 students' computers.

So much for the technical explanation.

Because what it really does is allow you to realize the full potential of the complete computer classroom.

By helping to make you a more effective teacher.

By allowing you to communicate with your students as never before.

And by doing it all at 20% less than the cost of individual standalone systems.

With the SchoolBus network in place, you'll be able to view any student's work — at any time — from your own station.

So you can see how well they're doing, even while they're doing it.

You can also exchange messages, suggest changes, or offer encouragement for a job well done.

Having this kind of capability (the kind that lets you be in more than one place at one time) is perfect for the programming lab, where the lesson is built line by line.

But SchoolBus can also be used to teach anything.

And make it easier than ever for everyone.

With SchoolBus, you can restrict student access to certain files. Like other students' files. Or your own.

And it also has a password capability to maintain the privacy of each student.

Student access to disk drives, printers, and software is also controlled by you. So you can tell your students exactly when and where to get on and off the system, and students never have to handle disks themselves.

SchoolBus is much more economical than individual standalone systems, because you don't have to buy disk drives for everyone in the room.

The same goes for printers.

And software. Since there's no need for anyone but you to have a program.

The savings can be as much as a third of the entire system cost.

What's more, the SchoolBus works with any of the Apple II family of systems.

The SchoolBus network is just part of Apple's Complete Classroom, including all the hardware you'll ever need, and more educational software than is available for any other personal computer.

One of our 1500 authorized Apple dealers can tell you more.

Just tell them you'd like to do some homework on the SchoolBus.

They'll know what you mean.

Soon there'll be just two kinds of people.
Those who use computers and those who use Apples.

Call (800) 538-9696 for the location of the authorized Apple dealer nearest you, or for information regarding our National Account Program. In Canada, call (800) 268-7796 or (800) 268-7637. Or write Apple Computer Inc., Advertising and Promotion Dept., 20525 Mariani Ave., Cupertino, CA 95014. ©1983 Apple Computer Inc.

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FREE FROM LIMITATIONS.
A TEACHER CAN UNLOCK IMAGINATIONS.

By 1985, fully 75% of all jobs will involve computers. So for today's teachers, selecting the right computer is an awesome responsibility. It's a decision you can feel confident about with Southwest Technical Products Corporation's S+ computer system. The S+ is specially designed for a student's tomorrow and a teacher's today. It's built tough. It's simple to operate. You can teach without becoming a hardware specialist.

The S+ is fluent in a variety of languages: BASIC, PASCAL, COBOL, FORTRAN, PILOT, FORTH, "C" and MUMPS and allows you simultaneous use in the classroom. This flexibility enables you to use your own curriculum, not a machine's version. The system also allows for individual learning styles. Students go as fast and as far as the teacher chooses.

Even though it's priced like a smaller personal computer, the S+ has the multi-task power and expansion abilities of a professional computer. It can grow with you and your students.

Tomorrow is in your hands today. Call Fisher Scientific, exclusive distributor of our S+ system, and you'll get the key to unlock imaginations.

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Call toll free 800-621-4769.
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Compositional Syntactic Placement and Simple Concept Learning In Female Adults

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A paper presented at the national conference of the
Association for Educational Communication and Technology
Anaheim, California
January, 1985

ABSTRACT

The media attribute approach of this study hypothesized that compositional syntactic placement may serve to bridge the processing link between the learner's cognitive capacity and the demands of a simple concept attainment task. Specifically, this exploratory experiment was questioning whether a particular horizontal frame position was warranted in relation to two selected cognitive abilities: predictive ability and field articulation. Compositional syntactic placement was manipulated by producing three versions of a videotaped program that were identical in every respect with the exception of ten visual test stimuli. A nonequivalent-control group, treatment-by-blocks design was employed. Analysis of variance and multiple comparison techniques conducted on pretest posttest difference scores indicated compositional syntactic placement increased very significantly simple concept learning, and aptitude-treatment interactions were observed. The conclusion of the study recommends further experimental research be conducted on the media attribute theory with an aptitude network approach.

Compositional Syntactic Placement and Simple Concept Learning In Female Adults

The purpose of this exploratory inquiry was to investigate the media attribute, compositional syntactic placement, for potential aptitude-treatment interactions. Media attributes are one of the three predominant theories which have evolved in the last decade (Torkelson, 1984). Goodman's (1968) symbol system theory, Olson's (1976) theory of instructional means, and Salomon's (1979) media attribute theory have been succinctly summarized and analyzed by Snow and Salomon (in press) for the Third Handbook of Research on Teaching. All three theories have one implicit tenet in common: the need to examine the effects of selected media attributes on the internal cognitive processes of the learner.

Many symbol systems within media have the potential to facilitate or debilitate learning by calling upon different processing strategies (Bovy, 1981; Gagné, 1980). Some coding elements can save mental activity and thus ease the processing burden on unskilled learners; however, skilled learners, on the other hand, may show a decrement in cognitive processing under the same conditions (Cronbach & Snow, 1977). Those coding elements or media attributes which have the potential to affect cognitive processing may be identified by following Goodman (1968). Film and television entail a number of levels of articulation--the shot, the sequence, the syntagm, the whole program. Each of these requires its own rules and conventions of articulation that pertain to the transformation and composition of events, objects, and relations over time and space. These syntactic modes need not be the same for all levels of articulation. The way a single shot is composed differs from the way a whole sequence of shots is composed--e.g., high or low frame placement to indicate importance; left or right frame placement to indicate pre-dominance; parallel sequences to show comparison or contrast; parenthetical sequences to show different aspects of the same situation; and so on (Kjørup, 1977; Mascelli, 1965; Metz, 1974).

Compositional Syntactic Placement

Recognizing that there are numerous media attributes, this study focused on one coding system element, compositional syntactic placement. Compositional syntactic placement may be conceptualized as the relative horizontal position of the primary symbol or object within the frame--left, central, or right-- in relation to other secondary elements (Dondis, 1973; Zettl, 1973). Art historian Hienrich Wölfflins in his article "Uber das Rechts und Links im Blide" in 1928 (cited in Arnheim, 1954) was the first to call attention to the fact that pictures change appearance and lose meaning when turned into their mirror images. From his observations, he concluded that there is a general tendency for the eye to follow a path which begins at the left side of the picture and ends at the right. Wölfflins was able to describe the left-right phenomenon, but he was not able to explain it: "Apparently it has deep roots, roots that reach down to the nethermost foundations of our sensuous nature (p. 19)." Except for a few experiments with inconclusive results, scientific study regarding left, central, or right placement within visual media has been largely ignored (Metallinos, 1979).

None of the research to date has shown any cogently significant difference on aesthetic or learning variables in the placement of elements within the frame (e.g., Avery & Tiemens, 1975; Fletcher, 1977, 1980; Herbener, Van Tubergen & Whitlow, 1979). One study by Metallinos (1980) reported significant differences in that subjects were able to describe the shape ($p<.01$), to perceive color ($p<.001$), and to recall ($p<.02$) visual stimuli placed on the left side of the screen better than those placed on the right. Of those studies reporting trends, Metallinos (1975) and Metallinos and Tiemens (1977) reported that retention of visual (but not verbal) information in a newscast was enhanced by placement on the left side of the screen, while Niekamp (1981) reported that mean fixations of test stimuli measured by ocular photography favored the right. Hence, limited support favored the left orientation in dual comparisons (left vs. right placement), but a more accurate method of measurement indicated the right orientation. With the exception of the Metallinos and Metallinos-Tiemens studies, none of the experiments attempted to evaluate learning effects, and these researchers reported no significant difference. In summarizing the current state of knowledge, Niekamp (1981, p. 147) stated that the data "merely reflect the conflicting views and uncertain results found in the theoretical research literature . . . [and] . . . that these [left-right] differences may be a function of and are affected by individual human differences."

Cognitive Abilities

In regard to the cognitive abilities alluded to by Niekamp and Wolfflins, Snow and Salomon (1968) as well as others (Clark, 1975; Levie & Dickie, 1973; Salomon & Clark, 1977; Snow, 1970) have pointed out that individual aptitudes in the areas of intellectual abilities, cognitive styles and preferences, learning sets, information processing and coding strategies, and other subtle experimental variables are likely to interact in many complex ways with the instructional design variables of visual stimuli. Some evidence exists that two variables may have the potential to affect simple concept learning from a media attribute: field articulation and predictive ability.

Field Articulation. Gagné (1977) has specified that discrimination and generalization skills are basic to all concept learning. He noted that the learner must first distinguish relevant details (discriminate), then further organize this information as a basis for classifying new items as examples or nonexamples of a concept class (generalize). Learners appear to differ in their ability to discriminate and generalize, and the cognitive style construct, field articulation (field independence vs. field dependence), has been related empirically to these differences (Witkin, Oltman, Raskin & Karp, 1971). Previous research indicates that concept attainment tasks are often more demanding for field-dependent individuals (Dickstein, 1968; Kirschenbaum, 1968; Witkin, Moore, Goodenough & Cox, 1977). Individuals who are perceptually field-dependent have been found to experience their world in a less differentiated fashion when dealing with perceptual cognitive tasks (Witkin & Goodenough, 1976; Witkin, Goodenough & Oltman, 1977); that is, field-dependent persons tend to accept the visual field passively as presented and ignore important details which presumably are not salient to them. Furthermore, they appear to be dominated by the most salient or noticeable parts of a visual (Dickstein, 1968; Kirschenbaum, 1968). Their tendency to display less differentiated functioning is evident also in the processing strategies they use when directed to form a concept hypothesis. Their hypothesis-testing strategy has been associated with a partist approach which lacks organization (Goodenough, 1976; Kirschenbaum, 1968). Field-dependent learners may be handicapped by unstructured materials and a lack of salient details upon which to base their hypothesis. The difficulty of field-dependent learners may be particularly apparent when instructional time is limited by a fixed-paced presentation. Pishkin (1965) has suggested that specification of concept attributes, in some manner, may reduce learning difficulty for field-dependent individuals by reducing the number of hypotheses to be considered.

The field-dependent strategy may be contrasted with that of the field-dependent learners. These learners are capable of more differentiated functioning; that is, they are capable of using their restructuring skills as internal mediational processes (Witkin, Moore, Goodenough & Cox, 1977). Their hypothesis-testing strategies have been associated with a wholist approach which imposes organization (Goodenough, 1976; Kirschenbaum, 1968). Frederick (1968) has noted that only the more analytic learners are sensitive to amounts of relevant information. The field-independent learner tends to scan the first positive concept example and to retain all its attributes for later comparison with those in subsequent examples. If a hypothesis is proven to be inappropriate, then a revised hypothesis is formed. The wholist strategy of hypothsis testing is more active than the partist approach and has resulted in better learning performance particularly when subjects were under time pressure (Bruner, Goodnow & Austin, 1956; Bourne, 1966). In his discussion of hypothesis-testing strategies, Mayer (1977) pointed out that the superiority of the wholist strategy could be due to its reduced demand on memory, because the wholist is able to eliminate those attributes which fail to reappear.

Predictive Ability. The Predictive Ability Test was developed in the context of a theory of behavior which proposes that general ability can be estimated by the measurement of predictive ability (Friedman, 1974, 1975; Friedman & Willis, 1981). General ability (G) is a complex measure. The hierarchical model of ability organization, as interpreted by Cattell (1971), has at its highest level a distinction between fluid-analytic intelligence (G_f) and crystallized-verbal intelligence (G_c). After decades of factor analytic debate, this or related hierarchical views have finally become popular because they fit existing data rather well while offering some hope of parsimony (Snow, 1977, 1980). Horn (1976) summarized much recent correlational research under these rubrics, adding spatial visualization ability (G_v) to the general level. Cronbach and Snow (1977) adopted such a hierarchical view in attempting to make sense of a large number of studies which were designed to take into account learner aptitudes that might interact with media and task characteristics.

The Cronbach-Snow review noted that G has been the most widely studied aptitude construct in instructional media research and has produced the most aptitude-treatment interaction. The general hypothesis from the review is that as learners are required to organize their own study and build their own comprehension, the more able learners are capable of capitalizing on their strengths profitably. As instructional treatments were arranged to relieve learners from difficult reading, analyzing complex concepts and building their own cognitive structures, such treatments seemed to compensate for, or circumvent, less able learners' weaknesses and to reduce the regression slope of G. Some kinds of treatment-supplied cognitive models have actually interferred with the performance of high G students in instructional media research (e.g., Salomon, 1968, 1979). A "Zoom Film" reported by Salomon (1974) overtly supplanted the process of relating parts to wholes and thus facilitated learning for those subjects who could not easily execute that process on their own. However, the same supplanting element debilitated learning of better-skilled subjects apparently by interferring with their depth of processing. Also included in a second experiment of the study was an evaluation of field articulation (a measure of the fluid analytic (G_f) and spatial visualization (G_v) cluster of abilities according to Snow, 1977, 1980), resulting in the same aptitude-treatment interaction.

Considering the above selected cognitive abilities, the query of this research was to determine whether compositional syntactic placement was effective in improving simple concept learning from audiovisual media. This researcher was asking whether, under the impact of different learner attributes, a particular frame position was warranted. Performance by female subjects at different levels of these cognitive abilities was investigated with an instrument which sought to isolate simple concept learning derived from an instructional television program on women's sex roles produced in three compositional styles specifically for this study.

METHOD

Subjects

Female adults were chosen as the subjects, since women account for upwards to 75 percent of the participants in telecourse-centered and distance learning programs (Bryan & Forman, 1977; Zigerall, 1976).

Attendees to a nonformal workshop, "Sex Roles and How to Get Out of Them," conducted in the central Georgia area served as voluntary subjects. A total of 152 women completed all portions of the experiment. Age ranged from 19 to 72 years (_M_ = 38.96, _SD_ = 10.34), and the educational level attained ranged from 10 to 19 years (_M_ = 14.04, _SD_ = 2.05). None of the subjects were full-time students.

Materials

Stimuli. A nine-minute videotaped program entitled, "Obstacles to Career Growth--Sex Roles," was designed specifically for this experiment. The program contained ten simple concepts on sex role indicators which formed the basis for a stimuli set and for test questions. Each stimulus was constructed in three versions for left, right, and central syntactic placement by a graphic artist who controlled symbol size, color, and background. Three experimental tapes were carefully constructed with an electronic editor to ensure that each test stimulus was exactly the same length in all versions. The ten test stimuli embedded within the program were exposed on the screen from 7.66 to 13.60 seconds (_M_ = 10.72). Thus, the only difference between the left, right, and central versions of the experimental videotape was the composition of the test stimuli set.

The Criterion Tests. Two multiple-choice questions with five options were constructed for each of the ten sex role indicator concepts within the videotaped program. Two additional questions were added to insure comprehension of concepts that may have been confused with definitions derived from common usage. To determine if any life-history events might have altered significantly the characteristics of the groups, true-false questions on reading sex role material and on a personal encounter with a sex typing situation were included on the pretest. In order to reduce the length of the 22-item questionnaire to four pages, a modified matching format was utilized for the first twelve questions, since they involved definitions of concepts and attributes. The final reliability of the pretest-posttest criterion instruments determined during a pilot study was .76 as measured with the Kuder-Richardson Formula 20.

Predictive Ability Test (PAT). The PAT was developed in response to mounting criticism of intelligence tests in the early 1970's resulting from, (a) the lack of a definition and theory of intelligence, (b) cultural bias, (c) the similarity of intelligence test to achievement tests, and (d) the reliance of intelligence tests on verbal ability (Friedman, 1974). Predictive ability is a measure of general intelligence ability based upon the individual's aptitude to make prediction about events (Friedman, 1975; Friedman & Willis, 1981). This definition is based upon expectancy learning theory which defines learning in terms of the organism's ability to interact with the environment. While there is relatively little agreement on a definition, it should be remembered that some very old definitions of intelligence, from Binet on, include such phrases as "adaption to a goal," "capacity to reorganize behavior patterns for effective action," "maintenance of definite direction and concentration," "autocriticsm," and in sum, "ability to learn" (Snow, 1978).

The 30-item picture instrument requires the respondent to make predictions about events that are common to one's everyday experience, rather than about events which are generally learned in school. Sawyer

(1975) reported the test items have an average factor loading on the first principle axis (the predictive ability factor) of .49 with a range from .29 to .71. The proportion of common variance accounted for by the major factor in the unrotated solution (varimax rotation) was .47 with none of the other factors accounting for more than .09 of the variance. The PAT has a reliability of .90 as measured with the Kuder-Richardson 20 formula. The average difficulty index is .60 with a discrimination index of .53. During its standardization and initial study, the instrument correlated highly with different indexes of successful living--social adjustment, success in education, and job status. For the purpose of this exploratory study, the observed mean score on the PAT (19) was used to separate the subjects into two relative block groups: high or low ability.

Field Articulation. Field articulation is a cognitive style construct that is associated with competence at disembedding in perceptual and nonperceptual problem solving tasks (Messick, 1976). An individual who has difficulty disembedding simple figures from complex designs in the 18-item Group Embedded Figures Test (GEFT) is field dependent. A field dependent tends to be hindered in solving problems which require isolating an essential element from the context in which it is presented and using it in a different context. Individuals who do well on the GEFT are field independent and have the ability to delineate and structure perceptual and symbolic material (Witkin, Oltman, Raskin & Karp, 1971). Several studies have indicated that, although field-independent and field-dependent persons are not appreciably different in learning ability or memory, field-dependent persons tend to be better at learning and remembering social material. Field-dependent individuals also are more likely to require externally defined goals and reinforcements than field-dependent individuals who tend to have self-defined goals and reinforcements (Goldstein & Blackmen, 1978; Witkin, Moore, Goodenough & Cox, 1977). Furthermore, field-independent people are less inclined to be influenced by the environment and perform well in circumstances where critical elements of a problem have to be taken out of context and restructured in a different way, such as mathematical reasoning, verbal fluency, and spatial abilities (Witkin, Moore, Oltman, Goodenough, Friedman, Owen & Raskin, 1977). For the purpose of this exploratory study, the observed mean score on the GEFT (8) was used to separate the subjects into two relative block groups: field-dependent and field-independent.

Apparatus

At the front of each classroom where the workshops were held, two Sony KV-1515 Trinitron color receivers with a 32 centimeter horizontal screen width were placed for optimal subject viewing. The test stimuli videotapes were played back on Sony VP-2000 U-matic videocassette players. Utilizing an internal radio frequency generator, the signal from the videocassette was delivered to each monitor by cable through an Archer two-way splitter and directional coupler (Catalog No. 15-1141B). Color bars, audio tone and a cross hatch pattern recorded from a Lenco PFM-300 signal generator on the beginning of each stimulus tape were utilized to ensure that every monitor reproduced the audio and video signals accurately. Horizontal and vertical picture deflections were adjusted by a television engineer prior to the experiment so there was less than five millimeters deviation for all monitors in the classrooms.

Procedure

The nonequivalent-control-group design was utilized (Campbell & Stanley, 1963). A total of six workshop sessions were conducted, and randomization of the treatment videotapes was employed. A double blind technique was applied to help reduce the effect of reactive arrangements. Subjects were unaware they were participating in an experiment until the conclusion of the workshop, and the workshop leaders as well as test administrators were unaware of which treatment was being administered. All workshop leaders had advanced degrees in counseling and guidance or clinical psychology, and all test administrators had formal instruction in testing and measurement. Three training sessions totaling over four hours were conducted for these six individuals prior to the workshop sessions.

Every workshop followed the same format. Participants were encouraged to seat themselves at the front of the classroom in order that (a) no one be farther away than 12 times the horizontal width of the television receiver screen, and (b) a line of vision of not more than 45 degrees from the center line axis perpendicular to the picture tube be maintained as a maximum viewing angle (Chapman, 1960). After an initial overview of the session by the trained female workshop leader, the pretest was administered and followed immediately by the syntactic visual treatment and then the posttest. This eliminated any incidental learning which might have been contributed by the discussion period which ensued. Subsequent to the discussion period and a short break, the PAT and GEFT were completed by the participants under the supervision of the trained female test administrator. In the final segment of the workshop, attendees were informed that grouped scores would be used by the Center for Continuing Education of Women at Mercer University in developing future workshops and in a study on developing videotaped materials.

RESULTS

Group Equivalence

Since the experiment utilized six intact groups, two for each of the three treatments, equivalence of the three combined groups ($\underline{n}_{left}$=50, $\underline{n}_{center}$=52, $\underline{n}_{right}$=50) was an important question to investigate prior to testing for the experimental hypothesis. A three level, one-way analysis of variance was used in analyzing the data between the groups for each subject background and aptitude variable: age, $\underline{F}$ (2,149) = .03, $\underline{M}$ = 38.96; educational level, $\underline{F}$ (2,149) = 1.30, $\underline{M}$ = 14.03; predictive ability, $\underline{F}$ (2,149) = 1.72, $\underline{M}$ = 18.49; field articulation, $\underline{F}$ (2,149) = .19, $\underline{M}$ = 8.47; pretest score, $\underline{F}$ (2,149) = 1.16, $\underline{M}$ = 9.99. The results showed no significant differences between the groups on any of the variables at the .05 level of significance.

To determine if the subjects had dissimilar life-history experiences which might have altered the equivalence of the groups, the two true-false questions on the pretest were analyzed using the independent samples Chi-Square Test. No significant differences were noted between the groups at the .05 level for subjects having read within the last month sex role materials, $\chi^2(2,\underline{N}=152)$ = .19, or having had a recent encounter with a sex typing situation, $\chi^2(2,\underline{N}=152)$ = .53. Most subjects responded in the negative to these two questions with 57.9% and 59.9%, respectively, circling false.

Analysis of Variance

A 3 X 2 X 2 unweighted means analysis of variance was conducted to test the major hypothesis of the study. The three independent variables were compositional syntactic placement, predictive ability, and field articulation. The dependent measure was pretest-posttest difference scores. Table 1 presents a summary of the analysis.

Insert Table 1 about here.

The analysis of variance resulted in a highly significant main effect for compositional syntactic placement, $F\ (2,140) = 19.92$, $p < .0001$. A significant main effect was also achieved for field articulation, $F\ (1,140) = 6.23$, $p < .05$, with field-independent subjects achieving higher mean difference scores ($M = 5.31$) than field-dependent subjects ($M = 3.84$). Two significant first-order interactions were observed as well, requiring caution in the interpretation of the main effects: placement by field articulation, $F\ (2,140) = 3.56$, $p < .05$, and ability by field articulation, $F\ (1,140) = 9.76$, $p < .01$. While not significant, the second-order interaction, placement by ability by field articulation, was at the $\alpha = .10$ level, $F\ (2,140) = 2.32$.

Scheffé's (1953) S method was used to assess significant contrasts for the compositional syntactic placement main effect. Subjects who received the right syntactic treatment achieved a significantly greater mean difference score ($M = 6.66$) than either the left ($M = 4.32$, $p < .01$) or the central ($M = 2.60$, $p < 001$) placement groups. Subjects who received the left syntactic treatment also scored significantly higher than the central placement group ($p < .05$).

With two significant first-order interactions and a second-order interaction approaching significance, test of simple main effects were applied at all levels of one factor at each separate level of the other factor (Kirk, 1968) for intereactions involving compositional syntactic placement, field articulation, and ability (See Table 2).

Insert Table 2 about here.

The test of simple main effects revealed a significant interaction at less than .01 level for placement at field independence, F (2,140) = 16.92, and placement at field dependence F (2,140) = 8.11. Field articulation at right snytactic placement was also significant at less than the .01 level, F (1,140) = 13.09 (See Figure 1).

Insert Figure 1 about here.

Scheffé's S method applied to compositional syntactic placement at field independence (See Table 3) and compositional syntactic placement at field dependence (See Table 4) provided further information to aid in the understanding of the interaction.

Insert Table 3 and Table 4 about here.

Subjects in the field-independent, right stimulus group had a significantly higher mean difference score ($\underline{M}$ = 8.46) than those in the field-independent, central group ($\underline{M}$ = 3.26, $\underline{p}<.001$) or those in the field-independent, left group ($\underline{M}$ = 4.05, $\underline{p}<.001$). Similarly, subjects in the field-dependent right group had a significantly higher mean difference score ($\underline{M}$ = 5.00) than those in the field-dependent, central group ($\underline{M}$ = 1.88, $\underline{p}<.01$); however, the mean difference score for the field-dependent, left group ($\underline{M}$ = 4.54) only approached significance from the field-dependent, central group. Thus, a disordinal interaction occurred for the left stimulus group. Field-dependent subjects had higher mean pretest-posttest difference scores than field-independent subjects in the left stimulus group, contrary to the other two groups where field-independent subjects scored higher.

The difference in gain scores was significant for high and low ability subjects when considering their field articulation. The test of simple main effects revealed a significant interaction at less than the .05 level for ability at field independence, $\underline{F}$ (1,140) = 6.62, and a significant interaction at less than the .01 level for field articulation at low ability, $\underline{F}$ (1,140) = 16.01 (See Figure 2). Low ability, field independent subjects had a significantly higher mean difference score ($\underline{M}$ = 6.18) than either their low ability, field-dependent counterparts ($\underline{M}$ = 3.06) or high ability, field-independent subjects ($\underline{M}$ = 4.40),

Insert Figure 2 about here.

but they did not differ significantly from high ability, field-dependent subjects (M = 4.75).

Though not significant (p =.10), a graph of the placement by ability by field articulation interaction will ameliorate our understanding of the experimental variables effect (See Figure 3). For the low ability field-independent subject, these data showed that right syntactic placement was superior to the other two orientations. High ability, field-independent and high ability, field-dependent subjects also performed superiorly in the right syntactic placement group. The performance of the low ability, field-dependent subject was an entirely different matter. These subjects performed better in the left syntactic placement group. Notice that the graph represented in Figure 3 for the central and right syntactic groups mirrored the ability by field articulation interaction presented in Figure 2 (though at a wider angle), whereas the graph for the left syntactic placement group was exactly the 180 degree inverse of Figure 1. Unfortunately, this second order interaction only had limited support.

Insert Figure 3 about here.

DISCUSSION

The syntactic placement of visual symbols within a videotaped presentation was shown to increase concept learning for female adults, regardless of whether the symbol was in the left or right orientation; however, the right syntactic placement was predominantly superior. This effect for placement was not to be expected based on previous research, since six of the seven aesthetic studies reviewed dealing with syntactic placement found no significant difference. The one study (Metallinos, 1980) that reported significant differences found only that subjects were able to describe the shape and to recall the stimuli placed on the left side of the screen better than those placed on the right. While not significant, Niekamp (1981) had reported mean fixations of test stimuli measured by ocular photography favored the right. The disrepancy between these results and the previous studies may be attributed to the less distinctive visuals utilized in the experiments, such as the generic visuals of a newscast (e.g., themis for law stories, the caduceus for medical stories) or the more universal visuals of exploratory aesthetic research (e.g., circles, pastoral scenery). Metallinos (1975) and Metallinos and Tiemens (1977) noted this possibility as well.

Results from the pretest-posttest difference scores, confirmed that learners with field-dependent aptitudes have difficulty with externally-paced concept attainment tasks which require the ability to discriminate essential information (Dickstein, 1968; Kirschenbaum, 1968; Witkin, Moore, Goodenough & Cox, 1977). Field-dependent subjects' performances were influenced by visual orientation but not to the same level of performance as their counterparts. Field-independent subjects' performances on mean gain scores were facilitated highly through the use of right syntactic placement as opposed to central or left syntactic placement. This finding was in agreement with that of Frederick (1968) who found that only more analytic learners were sensitive to amounts of relevant information and with that of Salomon (1974, 1979) who observed that modeling cue attendance favored only the highly field-independent learners.

It appears possible that right compositional syntactic placement decreased abstraction time and processing effort which permitted more efficient and effective processing by both field-independent and field-dependent subjects, though field-dependent individuals may still have had greater difficulty in isolating relevant information. Perhaps other combined functional attributes were needed to provide a more powerful cue-summation effect for field-dependent learners to supplant their processing weaknesses.

In light of an aptitude interconnection or aptitude complexes explanation the findings from the two-way interaction of predictive ability and field articulation warrant consideration. While predictive ability did not interact with compositional syntactic placement as visual modeling of a mental skill (cue attendance) interacted with general ability in Salomon's (1968, 1974, 1979) studies, the resulting two-way trait interaction suggested that certain combinations of ability and field articualtion may have differentially affected learner outcomes. Although the right compositional syntactic placement facilitated simple concept learning for all field-articulate learners, the two-way interaction of variables implied that a specific placement condition may provide effective compensatory supplantation for high ability, field-dependent learners. Furthermore, a different placement condition may also function to maximize the appropriate processing modes of the low ability, field-independent learners.

Limited support for this interpretation is provided further by the three-way interaction of field articulation, predictive ability, and compositional syntactic placement ($\underline{p}$ = .10). The utilization of syntactic placement appeared to reduce processing and time demands which functioned to isolate, emphasize, and organize relevant information for the high ability, field-dependent learner. In fact, this orientation provided superior cue-summation for all but the low ability, field-dependent learner. Apparently, the right orientation added slightly to the processing demands of the low ability, field-dependent learner, whereas the left orientation aided this learner by isolating and directing attention to the relevant concept details. The left treatment condition was the only one in which the low ability, field-dependent subjects outperformed their high ability, field-dependent counterparts.

The general superiority for compositional syntactic placement may be taken as tentative support for Saloman's (1979) media attribute theory, where the choice of specific coding elements within a symbol system may effect the ease with which information is processed by a learner. These external stimulus cue summations may have increased both learning efficiency and effectiveness by reducing the number of possible hypotheses (Pishkin, 1965), which may have been helpful in reducing the memory demands associated with field-dependent hypothesis-testing strategies (Mayer, 1977). By providing ready-made transformations, the instructional materials may have compensated for the learner's deficiency by providing a mode of presentation that the learner could not provide (Snow, 1970). In other words, the compensatory treatments achieved for the learners what they could not do for themselves because of a particular aptitude weakness in discriminating relevant cues (Salomon, 1974).

This research has opened the door to the study of media attributes or coding systems and their relation to learner attributes. Cronbach and Snow (1977) have suggested that the design of instruction should be selective according to aptitude. Their emphasis is directed towards the choice of appropriate instructional techniques, rather than the selection of a medium as an invariant entity. This view is particularly appropriate when considering the implications for instructional practice suggested by this study. First, the results suggest practical recommendations in terms of the specific processes reflected by field-dependent and field-independent female learners when dealing with compositional syntactic placement in kinetic media. Second, the findings support the view that the design of instruction should be selective according to aptitude because of cognitive style differences in processing information on a simple concept attainment task. Although the same compositional syntactic treatments often facilitated both field-dependent and field-independent performance, one important implication should not be overlooked. While the effective treatments permitted field-independent individuals to perform more successfully, these same treatments may have been imperative for acceptable performance by field-dependent learners who may have needed specific supplantation in order to meet a basic performance criterion.

While not a rigid test of the general hypotheses due to the specific content and type of learning designed for a specific audience, this study has indicated more research is warranted in the area of aptitude capacities of the learner and the attributes of kinetic media. In addition to compositional syntactic placement or asymmetry of the screen, Zettl (1973) has recognized other coding systems within the frame: main direction of horizontal and vertical orientations, attraction of symbol mass, figure-ground relationships, psychological closure and vectors or directional lines as well as movement. Kjørup (1977) and Metz (1974) have identified syntaxes beyond the level of the shot with shots forming sequences, sequences forming syntagms, and syntagms forming the whole program. The systematic study of these media attributes may establish a solid structure upon which instructional programs may be built, especially when learner traits are used in the measurement.

In regard to learner abilities, more fruitful research may result from the intercorrelational aptitude paradigm of Snow (1980). Snow has noted that fluid ability skills (G_f)--a constellation consisting of abstract and often nonverbal reasoning tests and some spatial and figural tests--should relate to learning outcomes under instructional conditions that are in some sense new, unlike those that the individual learner has faced in the past. Ability to apply learning skills crystallized previously (G_c) would not be relevant here, but ability to adapt to new kinds of learning or performance requirements (G_f) would be relevant. Snow (1980, p. 59) has predicted:

> ...that as an instructional situation involves combinations of a new technology (e.g., computerized instruction or television), new symbol systems (e.g., computer graphics or artistic expression), new content (e.g., topological mathematics or astrophysics), and/or new contexts (e.g., independent learning, collaborative teamwork in simulation games), G_f should become important and G_c less important.

Therefore, G_f tests that measure to a greater degree the kinds of assembly and control processes needed to organize on a short-term basis adaptive strategies for solving novel problems should be included in studies on interaction effects of learner and media attributes.

With the increased utilization of television and videotaped programs in education to reach new student populations, the developed learning procedures need to acknowledge the relationship between the processing capacity of the learner and the processing demands of the media task. Consequently, educators should tailor materials to fit the aptitude predispositions of learners. In so doing, they may promote a regard for the individual that is made possible through aptitude-sensitive instruction, placing emphasis on the single most important component of an educational experience--the learner. This study has taken a preliminary step into the myrid of questions regarding the impact of media attributes on aptitude capacities of the adult learner. The results of this exploratory venture fostered more questions than answers. Nevertheless, this initial effort has served to bring into focus the important issue of learner interaction with media attributes for education.

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TABLE 1

COMPOSITIONAL SYNTACTIC PLACEMENT X ABILITY X FIELD ARTICULATION SUMMARY OF THREE-WAY ANALYSIS OF VARIANCE

Source of Variation	SS	df	MS	F
Compositional Syntactic Placement (P)	453.99	2	227.00	19.92***
Ability (A)	.07	1	.07	.01
Field Articulation (F)	71.04	1	71.04	6.23*
P X A	4.38	2	2.19	.19
P X F	81.12	2	40.56	3.56*
A X F	111.22	1	111.22	9.76**
P X A X F	52.82	2	26.41	2.32
Error	1595.32	140	11.40	

*$p < .05$
**$p < .01$
***$p < .0001$

TABLE 2

SIMPLE MAIN EFFECTS ANALYSIS OF VARIANCE

Source of Variation	SS	df	MS	F
Compositional Syntactic Placement (P)	453.99	2	227.00	19.92
P at F_I	385.82	2	192.91	16.92**
P at F_D	184.94	2	92.47	8.11**
Ability (A)	.07	1	.07	.01
A at F_I	75.42	1	75.42	6.62*
A at F_D	40.84	1	40.84	3.58
Field Articulation (F)	71.04	1	71.04	6.23
F at A_H	3.47	1	3.47	.30
F at A_L	182.46	1	182.46	16.01**
F at P_L	2.96	1	2.96	.26
F at P_C	24.69	1	24.69	2.17
F at P_R	149.26	1	149.26	13.09**
P X A	4.38	2	2.19	.19
P X F	81.12	2	40.56	3.56
A X F	111.22	1	111.22	9.76
P X A X F	52.82	2	26.41	2.32
Error	1595.32	140	11.40	

*$p < .025$
**$p < .001$

Note. F ratios were tested at the α/q level of significance, where q equals the number of variance levels (Kirk, 1968).

TABLE 3

RESULTS OF SCHEFFÉ'S S METHOD OF ANALYSIS FOR COMPOSITIONAL SYNTACTIC PLACEMENT AT FIELD INDEPENDENCE

Group	Field-Independent Right	Field-Independent Left	Field-Independent Center
n	24	22	27
$\bar{X}$	8.46	4.05	3.26

TABLE 4

RESULTS OF SCHEFFE'S S METHOD OF ANALYSIS FOR COMPOSITIONAL SYNTACTIC PLACEMENT AT FIELD DEPENDENCE

Group	Field-Dependent Right	Field-Dependent Left	Field-Dependent Center
n	26	28	25
$\bar{X}$	5.00	4.54	1.88

FIGURE 1

FIRST-ORDER INTERACTION OF VISUAL GROUPS BY FIELD ARTICULATION ON MEAN GAIN SCORES OF PREDICTIVE ABILITY

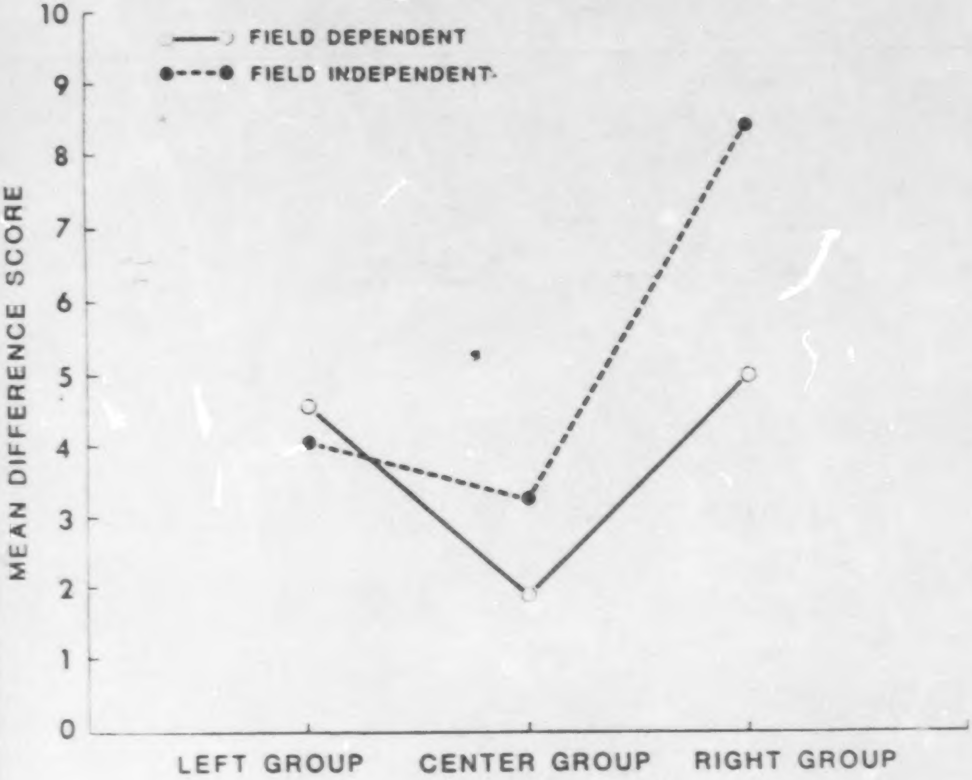


FIGURE 2

FIRST-ORDER INTERACTION OF PREDICTIVE ABILITY BY FIELD ARTICULATION ON MEAN GAIN SCORES OF VISUAL GROUPS

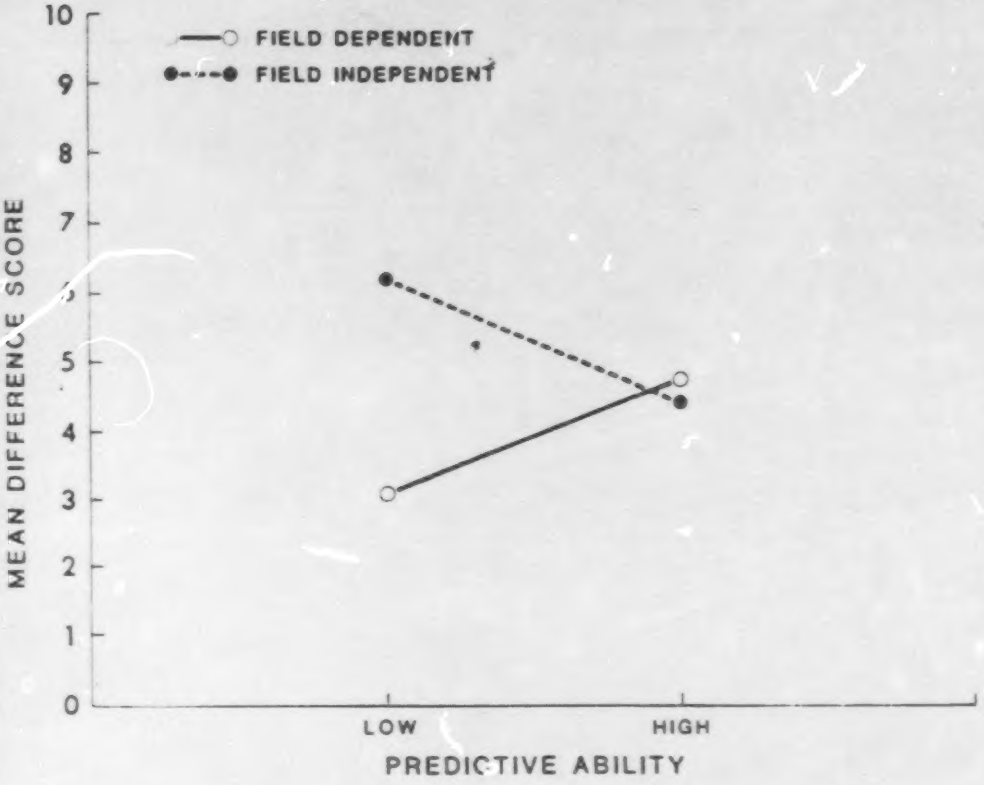
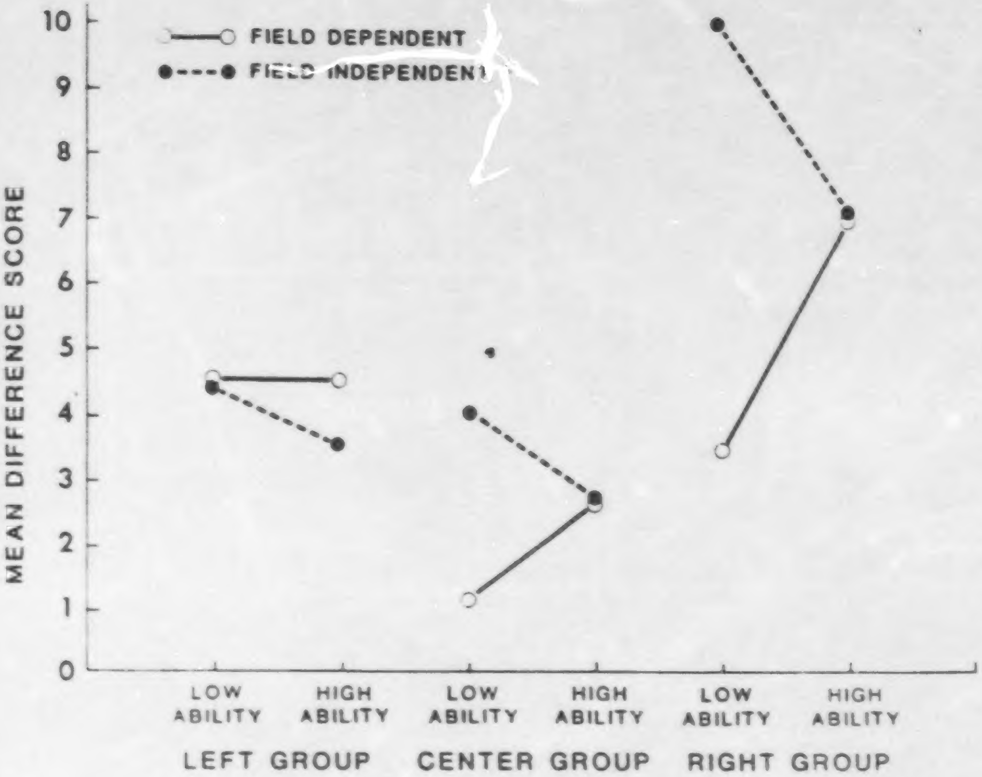


FIGURE 3

SECOND-ORDER INTERACTION OF VISUAL GROUPS BY FIELD ARTICULATION BY PREDICTIVE ABILITY ON MEAN GAIN SCORES



COMPETENCIES OF CURRICULUM MATERIALS CENTER DIRECTORS IN TEACHER-EDUCATION INSTITUTIONS by May Lein Ho

PURPOSE AND RATIONALE

The social and economic changes of the 20th century have had a profound impact upon school curriculum and methodology. Greater professional responsibilities have been placed on the classroom teacher, one of which is the ability to integrate into a learning situation carefully selected instructional materials. Such competencies as finding, evaluating, selecting, utilizing, and re-evaluating curriculum materials and activities are considered to be the fundamental prerequisites of a potential teacher.

To make certain that the classroom teachers have developed these desired knowledge, skills, and understanding in the program of professional education, it is essential for those who are responsible for the education of teachers to provide the prospective teachers with quick and easy access to all types of instructional materials. Arnett (1965:3) suggested:

> Only as the pre-service educational period provides him with these materials as he prepares his various assignments of his instructional planning, can he learn to find the ones he might use, to evaluate them as to their potentiality in the educative process, to select what will be proper for his pupils, to utilize them so that they manifest their full potentialities, and finally to re-evaluate them for future use or, even, for future rejection.

The idea of having a collection of textbooks, samples of curriculum guides, research and teaching units, lesson plans, and audiovisual materials set aside emerged as early as in the 1920's (Kerr, 1979:5). For many years, "curriculum laboratory" was used as a standard term to identify this type of facility. In recent years, many names have appeared including curriculum center, curriculum library, curriculum materials center, educational materials center, and learning resources center, to name but a few (Povsic and Junion, 1983:3). In this study, the term generally used was "curriculum materials center" and the professional directly in charge of the center was entitled "director."

The importance and justification of curriculum materials centers was recognized by the National Council for Accreditation of Teacher Education (NCATE) in the 1960's (Kerr, 1979:6). Since then, the curriculum materials center has been one of the criteria for certification of the teacher education program in schools of education. Section 5.2 of the 1979 NCATE Standards for the Accreditation of Teacher Education stated that appropriate materials and instructional media should be provided and that a materials and instructional media center for teacher education should be maintained either as a part of the library or as one or more separate units to support the teacher educational program (NCATE, 1979:10).

Despite the fact that curriculum materials centers are justified as one of the requirements for accreditation of a college of teacher education, and most colleges and universities have curriculum materials in specialized collections, there are still no standards or guidelines set specially for them, nor are there criteria which are met by all (Kerr, 1979:10). The curriculum materials center has long been directed on a trial-and-error basis, with tremendous variation in priorities among different universities (Houlihan, 1978:363). In terms of the staffing, there is not only ambiguity regarding the leadership role of the staff, but there are also differences of opinions as to the competencies and skills which the staff should possess (James, 1963:101). Several studies revealed that no standardized pattern has been stated in the way they are employed, their qualifications, and the number of hours their services are available in the center (Bhattarai, 1972:58). NCATE (1979:24), in the Standards for the Accreditation of Teacher Education, simply suggested that the center should be directed by personnel who are knowledgeable about instructional media and materials.

The purpose of this study was to identify and analyze job competencies deemed essential for a curriculum materials center director in teacher-education institutions as perceived by selected current curriculum materials center directors and a specified group of educators. The extent to which specific tasks were performed by the curriculum materials center directors was investigated. In addition, this study described the characteristics of the curriculum materials centers and their directors in teacher-education institutions.

By identifying the tasks that a curriculum materials center director frequently performed and the job competencies essential for the director, this study would provide guidance to the administration of teacher-education institutions when recruiting a person in charge of the center. Current curriculum materials center directors might utilize the results of the study to identify areas of need for continuing education and professional growth. Library media educators might find this study useful while designing or revising curricula to educate prospective administrative personnel with a goal that teacher-education institutions will offer better curriculum materials programs to meet the needs of faculty and students.

PROCEDURE

Two questionnaires were developed, one of which was designed for curriculum materials center directors; the other was designed for a group of educators related to the fields of educational media and technology, library and information science, or curriculum. Each questionnaire contained a list of 93 tasks. The 93 tasks were grouped into the following 10 categories: (1) Organization Management, (2) Personnel Management, (3) Materials Selection and Evaluation, (4) Technical Service, (5) Design and Development, (6) Production, (7) Utilization and Consultation, (8) Instruction, (9) Research, and (10) Leadership and Professionalism. Curriculum materials center directors were instructed to rate each task according to an Importance Scale and a Frequency Scale. Rating scale values of the Importance Scale were: (1) Not Important, (2) Somewhat Important, (3) Moderately Important, and (4) Very Important. The respondents expressed their opinions regarding how important it was for a curriculum materials center director to be competent in performing a specific task. In order to investigate the degree of frequency a specific task was performed by a director, the participating directors were requested to rate each task on the Frequency Scale. The scale values were assigned as follows: (1) Never, (2) Seldom, (3) Occasionally, and (4) Frequently. Instead of rating both scales, the professional educators were asked to weigh each task only under the Importance Scale and reveal their perceptions of job competencies that a curriculum materials center director should possess.

During the fall of 1983, the questionnaires were sent to 183 curriculum materials center directors in teacher-education institutions and 100 selected professional educators throughout the United States. Eighty-six questionnaires were returned by the educators, 81 (81 percent) of which could be used for data analysis. Of the 153 returns from the directors, 114 (62.30 percent) responded to all items in the instrument.

Returned questionnaires were tabulated and analyzed to answer the 7 questions posed in the study. Distribution frequencies and percentages of responses were utilized to determine personal and professional characteristics of the respondents and current status of the responding curriculum materials centers. In analyzing the 93 tasks, frequencies and percentages of the alternatives for each task were calculated and the mean rating of each item was computed. Items that received the highest rating from at least 51 percent of the respondents were reported. Rank order of tasks within each category and rank order of all tasks were obtained by utilizing item means. In order to determine, what, if any, statistically significant differences existed between the professional educators and curriculum materials center directors in emphasis placed upon individual competency and on various categories of competencies, a one-way analysis of variance design with .05 level of significance was applied to analyze the data.

FINDINGS

Analysis of data resulted in the following findings. For purpose of clarity, the findings were grouped into the following sections: (1) personal information concerning curriculum materials center directors, (2) information related to curriculum materials centers, (3) frequency of tasks performed by the directors, (4) importance of job competencies as perceived by the educators and the directors, and (5) differences of the two groups in emphasis on job competencies.

Personal Information Concerning Curriculum Materials Center Directors

One hundred eighteen directors responded to questions related to personal and professional characteristics of the directors, the following results were indicated:

1. The majority of the directors were female. Of the 118

respondents, 85 (72.03 percent) were women.

2. The greatest number of directors surveyed were from 31 to 40 years of age. The second largest age group was from 51 to 60 years of age.

3. There was considerable variation in titles assigned to persons in charge of curriculum materials facilities. Forty-nine titles were mentioned, 15 of which were used at least twice. The most commonly used title was director.

4. The majority of the directors were Caucasian in ethnicity. Of the 118 directors, 104 were in this category.

5. Of the 118 directors, 107 (90.68 percent) were at or beyond the master's level. A master's degree was the highest earned degree for 80 (67.80 percent) directors.

6. The responding directors indicated a wide variety of undergraduate major and minor fields of study. The most prominent master's major among 83 responses was Library Science. Most of the directors with doctoral degrees were in Curriculum and Instruction, Educational Technology, and Educational Administration and Supervision.

7. In terms of professional preparation, a significantly large number of directors had library science preparation. Of the 118 participating directors, 80 had more than 27 semester hours of library science preparation.

8. Nearly 30 percent of the directors had no more than 3 years of experience as a curriculum materials center director. On the other hand, slightly more than one-third of the directors had more than 10 years of experience as a curriculum materials center director.

9. Participating directors indicated that they had more work experiences at the higher education level than at any other level. More

than one-half of the directors had other library experience than curriculum materials center director experience.

10. The most prominent professional organization that directors joined was the state affiliate of the American Library Association.

Information Related to Curriculum Materials Centers

After data concerning the curriculum materials centers in teacher-education institutions were analyzed, the following findings were obtained:

1. The greatest number of institutions surveyed had student enrollments of 5,001 to 10,000.

2. Terms used to describe the participating curriculum materials facilities did not have uniformity. The term used most frequently was curriculum materials center.

3. More than one-half of the directors held full-time positions in curriculum materials centers.

4. The majority of the responding curriculum materials centers were under the control of the university main libraries.

5. Great variation existed regarding supporting staff. A vast majority of the responding centers indicated part-time student assistants.

6. In terms of annual budget for purchasing materials, nearly 56 percent of the centers had budgets of no more than $7,500. Nearly 80 percent of the centers had no budget for temporary use of materials.

7. Of the 118 centers, 28 had children and/or young adult collections of 5,001 to 10,000 items. Thirty-nine centers had 1,001 to 5,000 textbooks. Fifty-four centers had curriculum guide collections of 1,001 to 5,000. Nearly 62 percent of the centers indicated no more than 5,000 items of audiovisual materials.

8. The most common production equipment installed in the centers was the copy machine.

Frequency of Tasks Performed by the Directors

Of the 93 tasks investigated in the present study, 18 were performed frequently by at least 51 percent of the responding directors. When the mean for each task was calculated, 35 tasks were found to have means in the range of "occasionally" or "frequently." Assisting teachers and students in locating needed materials was the task most frequently performed by the directors. The task performed least frequently was to sponsor student-made productions for competition at fairs or conventions. Based on rank order of the 10 functional categories, Utilization and Consultation was ranked highest, while Production was ranked lowest.

Importance of Job Competencies as Perceived by the Educators and the Directors

After data gathered from the Importance Scale were analyzed, 49 job competencies were rated as being very important by at least 51 percent of the educators, while 46 were perceived to be very important by at least 51 percent of the directors. Agreement was found on 38 competencies. The ability to plan, organize, and administer the center to reach goals was at the top of the list considered to be most important by both groups. Agreement was also found on the lowest ranked competency: to teach library media skills on demand to teachers and students. As for the categories of job competencies, Leadership & Professionalism was ranked highest, while Production was ranked lowest by both groups.

Differences of the Two Groups in Emphasis on Job Competencies

Of the 93 job competencies, one-way analysis of variance yielded a significant difference in 44 items (47.31 percent). The educators and the directors differed most in opinions on the competency of deciding whether curriculum materials should be produced locally. The educators rated this competency higher in importance than did the directors. In comparing mean ratings assigned by both groups, only 35 competencies investigated received higher director mean ratings. Significantly more items in the categories of Design & Development, Production, and Research had higher educators' means. In the category of Technical Service, however, more competencies had higher directors' means, 11 items out of 18. In terms of differences of opinions in regard to categories of job competencies, one-way analysis of variance revealed significant differences in 7 categories except Personnel Management, Technical Service, and Utilization & Consultation. The opinions of professional educators and curriculum materials center directors varied most in the category of Production.

CONCLUSIONS

Based upon the findings of this study, the following conclusions were drawn:

1. A majority of the curriculum materials center directors were library science oriented in terms of highest degree, master's major fields of study, professional preparation, work experiences, or professional organizations in which they participated. Specialities or qualifications related to educational media and technology or curriculum apparently were not widely evident among the curriculum materials center directors or administrators of teacher-education institutions as prerequisites for this position. Consequently, certain functions that curriculum materials centers ideally could perform might not be fully fulfilled or recognized due to directors' lack of professional preparation or background in certain areas.

2. Wide diversity existed among the curriculum materials centers. Common characteristics are difficult to identify, let alone any standard pattern or uniform policy. Curriculum materials centers appear to be operated differently in every respect in order to meet the individual needs of teacher-education institutions.

3. A majority of the activities in which curriculum materials center directors were frequently engaged were still oriented toward those related to traditional library activities. The frequency of a task performed by the directors was closely associated with directors' opinions in regard to the importance of being competent in performing that task. The directors tended to place more value on activities in which they were frequently involved. Utilization and Consultation, Leadership and Professionalism, and Organization Management were among the highest ranked categories in task performance and importance rating. On the other hand, the directors were minimally involved in activities related to Design and Development, Production, or Research. Therefore, the active and leading role a curriculum materials center director can play in Design and Development, Production, or Research also was not widely accepted as being very important among the directors.

4. Even though provision of production equipment and facilities to assist faculty members or students in producing curriculum materials has been proposed for years as one of the important functions a curriculum materials center should perform, production equipment or facilities were not very popular among the participating curriculum materials centers. Different arrangements for provision of production equipment or facilities may exist in those teacher-education institutions with no production equipment or facilities installed in the curriculum materials centers.

5. There are areas of agreements between the curriculum materials center directors and professional educators in regard to the competencies considered to be very important to curriculum materials center directors. The 38 competencies that the majority of both groups considered to be very important represent a basic set of common qualifications for a curriculum materials center director that can be useful to the current directors, library media educators, and administrators of teacher-education institutions.

6. There are also areas of differences between the participating directors and educators concerning the competencies essential to curriculum materials center directors. On the one hand, the competencies that a director should possess as expressed by the professional educators represent ideal goals that may lead to betterment of the profession. On the other hand, the professional ideals may not be consistent with what actually happens in the curriculum materials centers. Discrepancies may exist between the professional ideal and the reality of the curriculum materials centers.

RECOMMENDATIONS fOR FUTURE STUDY

Results of the present study suggest a number of areas for further investigation. The following are recommended:

1. Detailed guidelines and standards for a curriculum materials center in teacher-education institutions, distinct from those for other settings, should be developed. A written statement of the requisite competencies, qualifications, and academic preparation a curriculum materials center director needs to possess should be prepared and kept up-to-date. Joint efforts to achieve this goal from such nation-wide professional organizations as the American Library Association and the

Association for Educational Communications and Technology is strongly recommended.

2. The present study excluded institutions which had a curriculum materials center but did not have a professional in charge, or which did not have a curriculum materials center as defined in this study. A national study needs to be conducted to include all the institutions accredited by the National Council for Accreditation of Teacher Education so that more information can be obtained concerning how curriculum materials are provided in those teacher-education institutions which arrange different access for faculty members or students to curriculum materials.

3. A need exists to conduct an in-depth study as to the organization, purposes, functions, staffing, and services of existing curriculum materials centers. Evaluative criteria should be developed so that an evaluation type of study could be conducted concerning curriculum materials centers and the competency level of curriculum materials center directors when compared to the tasks performed by the directors.

4. A study should be conducted to investigate how curriculum materials centers are used by faculty members and students. Needs of faculty members and students in regard to services and programs of curriculum materials centers also should be examined.

5. A study should be conducted to examine how production equipment and facilities are provided in the teacher-education institutions if they are not installed in the curriculum materials centers. Advantages and disadvantages of different arrangements should be investigated.

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Using Imagery Training
to Solve Puzzles

by

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I believe imagery training is an important aspect to improve learning. Imagery training involves the following activities:

1. Teaching students to visualize their thoughts;
2. Helping students to make external representations of their internal thought processes;
3. Helping students to transfer their imagery training to solving visual and verbal problems.

Traditionally, teachers do not use imagery in the classroom. Teaching imagery to students may help them gain creative insights, organize thoughts and solve problems. Students also use imagery to organize information and simplify ideas. Imagery is the ability to create images of the mind to understand, learn and see experiences.

Training students to use imagery in their learning is important. Many teachers emphasize activities that involve verbal, analytical thought and ignore imagery learning. Two separate studies were conducted to train students to image in order that they might increase their imagery skills. It was hypothesized that students who were given training in imagery, would transfer those imagery skills for solving visual puzzles and verbal problems to a greater degree than those who did not receive imagery training.

In the first study seventy-eight (78) graduate students volunteered to participate. The experimental group (N = 29) was given a lecture and slide presentation designed to teach subjects about imagery. The lecture with slides included a definition of imagery, ways for students and teachers to use imagery in the classroom, examples of learning with imagery and exercises in solving visual puzzles through imagery. Both the experimental and control groups (N = 49) were given a Visual Puzzles Test, compiled from various puzzle books. This instrument was used to measure the ability of the subjects to solve visual puzzles. The test consisted of fourteen items and a score was determined by the sum of the items correctly answered.

T-tests were conducted between the experimental and control groups and between males and females on their score on the Visual Puzzles Test. The t-tests revealed significant differences between the experimental and control groups (t = 4.85, df = 76, p < .001). Due to a significant homogeneity of variance, the pooled variance estimate was used. There were no significant sex differences on the Visual Puzzles Test. The mean for the control group (N = 49) was 7.6 and for the experimental group (N = 29) the mean was 10.4.

The results of this study show that imagery training does facilitate transfer to solving visual puzzles. The Visual Puzzles Test can be easily duplicated by teachers and researchers by using the many puzzle and game books available.

In the second study a total of one hundred and thirty-three (133) graduate students volunteered to participate. The treatment group consisted of seventy-nine (79) subjects and the control group had fifty-four (54) subjects. The treatment group again received a slide and lecture presentation on imagery training. This time the treatment and control groups were given the Visual Thinking for Verbal Problems Test (VTVP). This instrument was used to measure the ability of the subjects to solve verbal problems using imagery techniques. The Visual Thinking for Verbal Problems Test was compiled from various game books. The test consisted of eight (8) items and a score was determined by the sum of the items correctly answered.

T-tests were performed between the treatment and control groups and between the males and females on their score on the Visual Thinking for Verbal Problems Test (VTVP). The t-tests revealed significant differences between the treatment group and the control group ($t = 10.25$, $df = 123$, $p < .001$). There were no significant sex differences on the Visual Thinking for Verbal Problems Test. The mean for the treatment group ($N = 79$) was 6.10 and the mean for the control group ($N = 54$) was 3.83.

Again, the results indicate that if subjects are given imagery training, they will be able to use imagery for solving verbal problems. It is apparent that the treatment was effective. I believe that teachers need to provide opportunities for imagery. I also believe that these two studies show the importance of allowing students to participate in the problem solving process. I was able to accomplish student participation by asking them to represent externally their thoughts on the instruments provided so that they could share their imagery with others. Further research and theory on visual thinking can be found in the references.

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A Function-Based Comparison of Illustrations Providing Literal and Analogical Representations on Comprehension of Expository Prose

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Introduction to the Study

The inclusion of visual illustrations in educational textbooks is a longstanding, practically universal practice. It can be determined from even the most rudimentary examination of currently used texts in both public schools and higher education that, regardless of subject or level, both publishers and educators seek texts which include a variety of visual representations. In light of the heavy reliance upon visuals in textbooks it seems appropriate that there would be empirical data to support this practice. Accordingly, several studies have been conducted which attempt to establish the relationship between pictures and accompanying text. However, to date research in this area has been non-conclusive. There are as many studies that indicate a lack of effect or a detrimental effect from illustrations in text as there are that indicate a positive effect (Duchastel, 1980).

It appears that the most valuable information gained from the majority of studies heretofore conducted concerning the relationship of illustrations and text is that there can be no generalizations made. One reason for this lack of conclusive evidence seems to be the inability to consider illustrations as complex, multivariate media. The type of illustration, its relationship to the text, its physical characteristics, its placement in the text, and the purpose of its existence in the learning situation are among the variables that will have a profound bearing on its effectiveness. As noted by Schramm (1977), the differences within a medium are not smaller than those between media.

That there are differences found within various illustrations is well known (Goodman, 1976; Salomon, 1979; Schramm, 1977). It appears that these differences are manifested in an interrelationship of message, media attributes and environment. The problem of identifying those attributes of illustrations that help increase learning from textual matter in various situations is one of the unanswered questions in this realm of research. Yet, to date research has touched only lightly on an examination of specific attributes of illustrations as they relate to text (Brody, 1982).

Salomon (1978) asserts that because they are composed of a complex, flexible variety of attributes, different media can be used for a variety of instructional endeavors on a variety of levels. Following Schramm's (1977) statement concerning differences within a medium, Salomon's principle could also apply to the same medium used under different circumstances. In other words, the same medium could be used for a variety of instructional tasks and result in a variety of learning outcomes, based upon the circumstances of its use. Nevertheless, most research tends to examine the illustration as a whole rather than as a complex combination of attributes. In order to assess the value of an illustration as an instructional tool when it is used in conjunction with textual matter, each of the attributes found in the illustration and its relationships with other attributes must be examined.

In order that an accurate assessment of effectiveness be placed on an illustration used in conjunction with text, it is first necessary to determine the instructional function that illustration is performing. Only after this determination is made can a comparison of effectiveness between pictorial formats occur. An illustration used in conjunction with text with no consideration as to what instructional role it is intended to serve might very well prove no more effective than no illustration; in fact, it might prove detrimental to pedagogical qualities of the text. But the fact that much research shows a positive effect from illustrations suggests that if an illustration serves an instructional function appropriate to the intended instructional outcome, it has value as a textual supplement.

The ability of an illustration to serve an appropriate function is dependent upon, among other things, the attributes present in the illustration and the relationship between the illustration and the text. Empirical studies have established that certain attributes of illustrations influence their instructional effectiveness (Levie and Lentz, 1982). Matching attributes to instructional functions can therefore be considered one essential step in establishing a data base for decisions about illustration-text relationships.

Recently, studies have been conducted to begin the task of matching attributes of illustrations to specified instructional functions. Much more information is needed before effective utilization of illustrations in textbooks can be assured. The present study is a further test of the attribute-function relationship of visual illustrations used with text. It examines the effectivenesss of illustrations providing analogical representation and illustrations providing literal representation in serving two specific instructional functions.

The primary hypotheses of the study are that illustrations providing analogical representation better serve the instructional function of visually clarifying abstract or nonphenomenal information, and that illustrations providing literal representation better serve the function of identifying physical properties of phenomenal information. The distinction between phenomenal and nonphenomenal information is the difference between information that does or does not have a tangible existence that can be recorded. Nonphenomenal information has no tangible existence or is too large, too small, too distant or too transient to be recorded (Knowlton, 1966). For example, voltage, which is defined as electromagnetic force and is derived by multiplying current by resistance, has no tangible existence and is therefore nonphenomenal. Phenomenal information has a tangible existence that can be recorded. A resistor, which alters voltage in a circuit, is composed of tangible substances such as metal wire and plastic, and therefore is phenomenal.

In terms of textbook utilization, the hypotheses of the study are that if an intended instructional function is to clarify nonphenomenal information, an illustration that provides an analogical representation is more likely to be effective. If the intended instructional function is to identify properties of phenomenal information, an illustration that provides a literal representation is more likely to be effective. Analogical illustrations are defined for this study as being functionally as well as physically different from literal, or realistic, illustrations. An illustration providing analogical representation is one in which a visual is used as a reference to information that is not literally identified by, but rather conceptually represented by, the visual. Its features usually do not resemble the features of the information it represents. This type of illustration is effectively used when the information it illustrates is nonphenomenal. For example, an illustration providing analogical representation could depict the effect of resistors on voltage in a circuit, even though voltage is nonphenomenal.

An illustration providing a literal representation, on the other hand, is a more salient representation of real phenomena, usually because it pictorially resembles such. Although all illustrations depart in some degree from real objects, for example in aspects such as dimensionality or size, an illustration possessing a physical resemblance to an object establishes a relatively more literal representation of the object than does an illustration not possessing a physical resemblance. In other words, if the object in an illustration can be identified by the viewer as that object, the illustration is providing a literal representation. An illustration physically resembling a resistor would provide literal representation. This type of illustration, often referred to as realistic, has traditionally been considered instructionally effective. Recently, resemblance and realism have been questioned as proper criteria for judging the appropriateness of visual materials. Salomon (1979) asserts that resemblance to a real object in visuals is at best superficial, and that the real meaning behind any communication is what is attributed to it by way of mental processes rather than a property of the message itself. Thus, for increasing comprehension, the illustration providing analogical representation might better illustrate information that would be difficult or impossible to illustrate literally, while the illustration providing literal representation might more effectively supplement an expository description of phenomenal information.

Experimental Procedures

Following a pilot study to determine validity and establish parameters of the experiment, the hypotheses were tested by assigning the reading of college level textual excerpts to two groups of college students. The groups each read two passages, one utilizing an illustration providing analogical representation of nonphenomenal information discussed in the passage, the other utilizing an illustration providing literal representation of phenomenal information discussed in the passage. While group one read a passage utilizing an illustration depicting an analogical representation, group two read the same passage utilizing an illustration depicting a literal representation. This procedure was reversed for the second passage. Thus, both groups read two passages, each one utilizing an illustration with a different depiction. Results of subsequent comprehension tests were analyzed to determine the relative effects of the illustrations on comprehension of phenomenal and nonphenomenal information within the passages.

The hypotheses were tested on 90 randomly selected male and 90 randomly selected female college undergraduates students. Then each of the two 90 subject groups was equally divided into two treatment groups. Thus, equal numbers of subjects were represented in each of the four groups.

Since the study is a test of comparative comprehension effects, it is necessary to remove as many other variables as possible from the population. Thus, a group of college students, who can be assumed to be skilled readers, will allow a more accurate assessment of the variables tested, since inability to perform well on a comprehension test could not be attributed to the subject's inability to read.

Two expository prose passages taken from college level texts were used in the study, one concerning photosynthesis in plants and one concerning the structure and function of human muscles. Both passages were selected from monographs currently or recently used as college level supplemental texts, to insure that the passages qualified as college level expository pieces.

When testing with higher level subjects and curriculum-based material, it is many times difficult to distinguish what is learned from what is already known. It was therefore decided to use passages that would contain information commonly attainable, but probably not overly familiar to college undergraduates, as determined by a pretest survey. The passages were also selected because of the high level of technicality and density of information contained in a short space as well as the presence of both performed on the gathered data, one acting as a replication study to the other. The passage variable was not incorporated into a single ANOVA so that it would be possible to isolate and emphasize predicted interactions between other variables, and because this experiment is not a comparison of comprehension of the two passages per se. Any possible loss of information occasioned by not testing this interaction is offset by the increase in power and ability to generalize brought about by the replication aspect of the study.

The analysis of variance tests devide the groups by task and treatment for each passage. A third division, gender of subjects, was used to test for any possible interaction between task and gender or treatment and gender. Thus, the three-way design incorporates type of illustration, type of question and gender variables into a factorial analysis.

Results

Comprehension performance tests for each of the passages were statistically analyzed separately. The passage concerning photosynthesis in plants was assessed first. Results were obtained concerning the differences between and within the blocked groups of subjects. The analysis of variance, shown in Table 1, identifies the interaction between treatments and tests as significant, F(1,176) = 83.34, p<.01.

Table 1

Photosynthesis in Plants Passage
Analysis of Variance
N = 180

Source	SS	df	MS	F
Between Groups	264	179		
Treatments	1.61	1	1.61	1.08
Gender	0.41	1	0.41	.28
Treatment X Gender	0.17	1	0.17	.11
Groups w/Treat,Gen	261.81	176	1.49	
Within Groups	190.50	180		
Tests	0.41	1	0.41	.56
Treatments X Tests	60.84	1	60.84	83.34*
Tests X Gender	0.70	1	0.70	.96
Treat X Test X Gender	0.41	1	0.41	.56
Tests X Groups w Treatments X Gender	129.14	176	0.73	
Total	454.50	359		

* p<.01

As illustrated in Table 1, there were no significant differences for the main effects of treatment, gender and tests. There was a significant difference for the treatment x test interaction, which reflects the ability of subjects to respond correctly to different types of questions depending on the type of illustration provided in the passage. All other interactions were analyzed as nonsignificant.

The data supports the rejection of both the null hypotheses of this study. It indicates that there is a significant difference in ability of subjects to respond correctly to questions of a nonphenomenal and a phenomenal nature depending upon the type of visual illustration utilized in an expository passage. Specifically, in a textbook passage concerning photosynthesis of plants, more questions of a nonphenomenal nature were answered correctly by subjects who read the passage utilizing an illustration providing analogical representation than by subjects who read the same passage utilizing an illustration providing literal representation. Inversely, those students reading the passage utilizing the illustration providing literal representation answered more questions of a phenomenal nature correctly than did those reading the passage utilizing the illustration providing analogical representation.

The data derived from the replication test performed on the passage concerning the parts and functions of human muscles supports the results of the photosynthesis passage. Again, results were obtained concerning the differences between and within groups of subjects. The analysis of variance, shown in Table 2, again identifies the interaction between treatments and tests as significant, F(1,176) = 77.80, p>.01.

Table 2

Parts and Functions of the Human Muscle
Analysis of Variance
N = 180

Source	SS	df	MS	F
Between Groups	308.87	179		
Treatments	0.62	1	0.62	.35
Gender	0.62	1	0.62	.35
Treatments X Gender	0.23	1	0.23	.13
Groups w/Treat,Gen	307.40	176	1.75	
Within Groups	175.50	180		
Tests	0.02	1	0.02	.03
Treatments X Tests	53.68	1	53.68	77.80*
Tests X Gender	0.01	1	0.01	.01
Treat X Test X Gender	0.22	1	0.22	.32
Tests X Groups w/ Treatments X Gender	121.57	176	0.69	
Total	484.37	359		

* p<.01

Again the analysis of variance indicates a lack of significant difference for main effects of treatment, gender and tests, and for all interactions with the exception of the treatment x test interaction. The results of the replication test support the rejection of the null hypothesis reported from the first test. Again, there is a significant difference in ability of subjects to respond correctly to questions of a nonphenomenal and a phenomenal nature, depending upon the type of visual illustration utilized in conjunction with the text.

Lack of any significant difference within groups or of any interaction other than that between treatment and test in either analysis of variance indicates that in each situation the illustration was performing a specific instructional function that was not being served by the other type of visual representation.

Discussion and Recommendations

The data generated in this study support one of the basic premises of the functional approach to research on illustrations; functions served by illustrations must be viewed in terms of specific and precise instructional roles rather than more general instructional goals or outcome statements (Brody, 1983). In this study, illustrations were selected to serve two specific functions, with the intent of the selection and subsequent utilization being to aid in the achievement of an instructional outcome. Specifically, one illustration was selected to identify properties of phenomenal information introduced in an expository prose passage and one illustration was selected to clarify nonphenomenal information introduced in an expository prose passage. These are two examples of instructional functions which can be served by illustrations, viewed in terms of precise and specific instructional roles. The expected instructional outcome to be aided by these functions was comprehension of the prose passages read in conjunction with the illustrations.

Results of comprehension tests from both passages indicate that overall comprehension scores on the tests were similar regardless of the type of illustration utilized. This indicates that the presence of an illustration has a similar effect on overall comprehension of the passage. It also supports the long established positive correlation between the effectiveness of an illustration and its relevancy to the text (Halbert, 1943).

More important for this study, however, is the indication that the illustrations served specific instructional functions. The group that read the passage with an illustration which served the function of identifying properties of phenomenal information did significantly better on comprehension of that type of information than did the group reading the passage with an illustration serving another function. Conversely, the group reading the passage with an illustration which served the function of clarifying nonphenomenal information did significantly better on comprehension of that information than did the other group. Thus, it can be concluded that, while both illustrations were assisting in the overall comprehension of the passage, they served different functions to achieve this assistance, by addressing different types of information. Analysis of the data indicates that different types of information were more effectively comprehended, depending upon the illustration used with the passage.

Based upon the results of the empirical tests, it appears that there is not a significant difference between the ability of male and female students to utilize the illustrations for the specified instructional functions of this study. It could therefore be concluded that for college-aged students, no gender distinction is necessary when selecting illustrations to fulfill instructional functions.

Thus, the relationship between the instructional function served by an illustration and the instructional outcome aided by that function can be compared to the relationship between "means" and "end". Functions provide the means of achieving instructional ends. Further, the success or failure of an illustration to serve an instructional function depends, among other things, upon the appropriate selection of an illustration for that function and the effective implementation of that function in the text.

Data derived from this study concerning selection of illustrations to serve specified instructional functions indicates that there is an interaction between the type of representation provided by the illustration and the instructional function served by the illustration. Specifically, an illustration providing analogical representation, which, as defined in this study acts as an abstract representation of information, helps to clarify abstract or otherwise nonphenomenal information. Similarly, an illustration providing literal representation, which usually denotes a salient physical resemblance to phenomenal objects, helps to identify phenomenal information. Thus, it appears that achievement of different instructional functions may require the use of different types of illustrations in some cases.

Recommendations for Further Study

Several recommendations for further investigation concerning the functions that can be served by illustrations in text can be made. Initially, the results of this study support the need for more extensive investigation concerning illustrations serving instructional functions in relationship to textual matter. Tests similar to this one need to be conducted with students on various educational levels. Information as to what levels can effectively use illustrations providing analogical representation, for example, can add significantly to understanding of functional services of illustrations as well as many related areas of concern. Another area of investigation concerns the academic subjects introduced in the textual passages. Illustrations providing analogical representation and those providing literal representation should be created for subject disciplines outside the pure sciences, to increase ability to generalize and extend understanding of circumstances under which these representational types of illustrations can effectively serve instructional functions. Assessments should be made as to which subject disciplines lend themselves to these types of illustrations serving these functions.

There is also a need to conduct studies concerning the use of different types of representations serving functions identical or similar to the ones served in this study. For example, it would be valuable to know whether representations other than those providing analogical representation will effectively clarify nonphenomenal information. This should, of course, be conducted with a wide variety of representational forms. Closely related studies using a variety of representational formats which serve other instructional functions than the ones utilized in this study are also needed.

Tests could be constructed to see whether two illustrations, each serving a different function within a passage, would contribute more toward the achievement of instructional outcomes than one illustration serving one function. The basis of this hypothesis would be that instructional outcomes cannot necessarily be achieved in their entirety through achievement of one function. In many cases, a number of different functional operations, both pictorial and nonpictorial, may be needed to achieve an instructional outcome.

It would also be relevant to test whether a number of different functions could be served by the same illustration. For example, the illustration serving the function of identifying phenomenal information might also have served the function of emphasizing a point, providing examples, or directing attention.

Studies will also be necessary to assess the effectiveness of illustrations serving functions with literary forms other than expository prose. This will involve the application of various representational types to various functional operations for each of the literary forms investigated.

In short, this study is but one of many that will result in a better understanding of illustrations serving as instructional tools when used in conjunction with textual matter. The conclusiveness of the results of this study both necessitates and facilitates further investigation into this aspect of pictorial research.

Much of the recent literature concerning the use of illustrations in text has stressed the need for an assessment of the instructional function being served by the illustration. When an illustration is incorporated into textual matter, it should be serving a specific, pedagogically sound instructional function. Otherwise, the reader will probably not benefit from the illustration's inclusion in the text; in fact, the reader might be distracted from the text by the illustration, with no cognitive gain being derived from this distraction. Therefore, to the traditional criteria for selection of illustrations used with text must be added perhaps the most important criterion, instructional function intended to be served.

To determine whether an illustration will effectively serve an intended instructional function, a close examination of both the illustration's attributes and its relationship to the text must be made. Research has shown that illustrations are composed of a variety of attributes, pertaining to physical, instructional and relational qualities of the illustrations, and that these attributes affect the way in which illustrations can be used as instructional tools. Therefore, the attributes present in an illustration will account in part for its effectiveness in serving an instructional function.

In light of this, a study was developed to demonstrate the relative effectiveness of two illustrations, which possess differences concerning the type of representational format they provide in supplementing text, in serving two distinct instructional functions, both of which assist in the overall comprehension of a textual passage. The primary hypotheses of the study were that illustrations providing analogical representation better serve the instructional function of visually clarifying abstract or nonphenomenal information, and that illustrations providing literal representation better serve the function of identifying physical properties of phenomenal information.

The hypotheses were tested by assigning the reading of college level textual excerpts to two groups of college students. The groups each read two passages, one utilizing an illustration providing analogical representation of nonphenomenal information discussed in the passage, the other utilizing an illustration providing literal representation of phenomenal information discussed in the passage. While group one read a passage utilizing an illustration depicting an analogical representation, group two read the same passage utilizing an illustration depicting a literal representation. This procedure was reversed for the second passage. Thus, both groups read two passages, each one utilizing an illustration with a different depiction. Results of subsequent comprehension tests were analyzed to determine the relative effects of the illustrations on comprehension of phenomenal and nonphenomenal information within the passage.

The analyses of variance that were performed support the stated hypotheses of the study. Specifically, an illustration which provides a literal representation of information introduced in the passage was shown to be more effective in serving the instructional function of identifying physical properties of phenomenal information introduced in the text. Conversely, an illustration which provides an analogical representation of information introduced in the passage was shown to be more effective in serving the instructional function of clarifying nonphenomenal information in the text. These findings suggest that, in instructional situations similar to the one in this study, illustrations possessing literal representation are more effective than illustrations possessing analogical representation when the instructional function to be served is identification of properties of phenomenal information, and illustrations possessing analogical representation are more effective than illustrations possessing literal representation when the instructional function to be served is clarification of nonphenomenal information.

Thus, this study is one of many needed to provide a comprehensive analysis of illustrations functioning as instructional supplements to text. Until a thorough understanding of the relationship between attributes and functions of illustrations is achieved, textbooks will in all probability continue to include illustrations which do not fulfill their instructional potential.

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USING CASE STUDY METHODOLOGY TO DESCRIBE DEVELOPMENT COMMUNICATION PROGRAMS

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Using Case Study Methodology
To Describe Development Communication Programs

In the discipline of development communication, case study methodology has been widely used to describe and investigate activities of communication programs

Proven systematic methods of description and analysis are not universally available for the case study methodology in development communication situations. It falls to the researcher interested in developing a case, to piece together and build a framework for the description of a particular problem.

There are at least two major ways to organize case study data (Schatzman and Strauss, 1973). The first is straight description; it uses the theoretical and organizational schema of the discipline itself. The researcher simply employs a classificatory system and describes the case by that particular model. With analytic description, the classificatory system is developed from the data. Thus, new organizational and theoretical models can be developed.

Walton (1972) provides a brief checklist of what a general case study must describe. This includes

> ...longitudinal data from each of several phases-pre-intervention, intervention, and post-intervention;
>
> ...rigorous description of process especially during the intervention phase;
>
> ...conceptualization and theorization about the process itself, e.g. interactions, phases, critical incidents, and their effect on subsequent attitudes and actions. (p. 76)

In this paper twelve development communication case studies will be examined to uncover their organizational schema; these findings will be pooled to form a suggested framework for the design of future case studies in development communication.

Background

Definition of a Case Study. Mouley(1970) writes that a case study is

> "...designed to identify the antecedents responsible in a direct or indirect 'causative' way to the occurence of...the present case..." (p. 347)

Van Dalen (1973) echoes Mouley when he writes that a case study is "an intensive investigation of a social unit" (p. 207) in which the researcher gathers data about the topic of the study, examines the relationships, and then develops the description.

While not defining case study methodology, Kerlinger (1973) does describe ex post facto research as

> "systematic empirical inquiry in which the scientist does not have any direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulable. Inferences about relations among variables are made, with direct intervention, from concomitant variation of independent and dependent variables." (p.379)

Case study methodology is one type of ex post facto study.

In a paper analyzing the use of qualitative case studies in the social sciences, Wilson (1979) lists four factors common to case studies. First, case studies are particularistic; they describe real activities of a specific situation. Next, Wilson says that case studies are holistic; they describe a wide variety of variables and discuss their interrelationships. Case studies are longitudinal; they describe events over time. Finally, Wilson notes that case studies are qualitative; prose, quotes, and sample materials may be used to document the case. Based on these four generic qualities, Wilson goes on to define a case study as

> "...a process of research which tries to describe and analyze some entity in qualitative, complex, and comprehensive terms...as it unfolds over a period of time." (p.448)

The case study, then, has two recognizable parts; the first is descriptive while the second is analytical and diagnostic (Lombard, 1978; Schatzman and Strauss, 1973). This paper will use Wilson's definition as a guide in the development of the case study methodology to describe development communication programs. It will focus on the descriptive element of the case study.

Rationale for a Case Study. Before a researcher can fully utilize a particular methodology, a rationale must be provided. In development communication programs a case study methodology is often used for three reasons.

First, a case study provides information on applications of theoretical concerns in the real world (Lombard, 1978; Walton, 1972). As such, Ullman and Krasner (1966) noted that case studies "illustrate procedures and provide a source of ideas as to how problems may be approached." (p. 45). There is a trend among social scientists to describe activities in their natural setting (Wilson, 1977). This is because of the significant influence of the environment on human events and the divergence of results from laboratory studies of similar phenomenon (Barker, 1968; Willems and Raush, 1969). Kerlinger (1971) notes the realism of the field study and implies that it exists in the case study when he writes that there "can be no complaint of artificiality..." (p. 407).

A case study also provides a large range of detail (Riley, 1963). Rather than focusing on one particular area and selecting a limited number of aspects for examination, a researcher developing a case study gathers and describes a wide array of data. This data allows a researcher to illustrate theoretical concerns and to provide examples.

The second reason for espousing a case study methodology to describe development communication programs is that such a study uncovers relationships (Katz, 1953). Both Kerlinger (1973) and Mouley (1970) respectively argue that field studies and case studies are useful in describing and analyzing relationships. These relationships are what Riley (1963) calls "latent patterns" (p. 69), relations that the object under study may not be aware of completely.

Walton (1972) suggests that a case study methodology uncovers relationships when it

> allows the reader to identify with persons or place himself in role positions in the situation;
>
> captures the affective mood and other dynamic properties of the unfolding situation;
>
> separates the description from the conceptualization and generalization. (p. 77)

Thus the process element of a case study, the describing of relationships, is a second reason for using a case study in reporting a development communication program.

Finally, case study methodology has a heuristic quality. As the case is described and the variables examined, a variety of hypotheses tend to emerge. This heuristic quality links implementation to theory and provides meaning for concepts and documents them in new ways (Bennis, 1978; Ullman and Krasner, 1966). Case study methodology, Mouley (1970) argues, "probably makes its greatest contribution to the advancement of science as a source of hypotheses to be verified by more rigorous investigation" (p. 348).

In summary, there are three main reasons underlying the use of the case study in the area of development communication:

1. to illustrate and provide examples,
2. to uncover relationships, and
3. to develop suggestions for future action.

Limitations of the Methodology. As with any research methodology, the case study has certain limitations. The most important limitations are the number of variables encountered, the precision in description, the tendency to over-emphasize unusual events, and the generalizability of the findings.

The first restriction stems from the multiplicity of variables encountered (Kerlinger, 1973). Since it is a descriptive type of research , a case study tends to produce a plethora of information. Sorting and categorizing the information become extremely difficult.

Because of the complex nature of real events, the quantity of information generated, and the absence of experimental control devices, a case study may be unsystematic in its description (Campbell and Stanley, 1963). Contrasted with experimental and quasi-experimental designs, the lack of precision is a limiting factor.

Case study methodology has a "tendency to overemphasize unusual events or to distort them for dramatic effect..." (Van Dalen, 1973). Given the previously mentioned limitations, the researcher can develop a particular mind-set which "...may blind him to certain significant aspects of the situation" (Mouley, 1970, p. 349). This biased-viewpoint effect (Riley, 1963) might cause the selective recording and skewed analysis of the available information.

Possibly the greatest limitation encountered by the case study is the inability to generalize its findings. This stems from two separate problems: the collection and interpretation of dependable data and the case study methodology itself. Mouley (1970) comments on the readily available data:

> ...when these data were collected, present needs were not anticipated, and as a result, the data were probably not collected and recorded systematically enough to be dependable and understandable in the context of the present problems (p. 351).

Mouley then notes that "obtaining dependable data from which valid interpretations can be derived" (p. 348) is a major problem in using a case study method.

Analyzing and interpreting the data also cause problems. Because the quantity of information generated (Riley, 1963) and the lack of established guidelines (Kennedy, 1979), the synthesis "...must rely heavily on the investigator's judgment, if not intuition, as to...(the information's) relevance and significance" (Mouley, 1970).

Both the methods of collection and interpretation of data limit the case study in its ability to yield generalizations. No direct control of the independent variables takes place in a case study; further randomization is lacking. Methodologically speaking, control and randomization allow for a wider applicability of research findings. Thus the methodology of the case study differs from experimental research (Campbell and Stanley, 1963: Kerlinger, 1973; Kennedy, 1979).

These limitations to the case study method may be lessoned by developing a rigorous framework in which development communication programs can be described.

Method

Development communication case studies were selected based on their a) availability in the general literature, and b) ability to meet Wilson's (1979) criteria of a good case study--particularistic, holistic, longitudinal, and qualitative. Twelve case studies of development communication projects were then examined to determine what descriptive categories were held in common across cases and what new categories emerged. As each case was reviewed, the descriptive categories developed by the particular author or which were self-evident were listed. This listing was then put on a matrix , shown in Table 1.

Insert Table 1 About Here

Results

The matrix presented in Table 1 indicates that the categories below were mentioned in eleven or more case studies. They are listed in random order.

1. Channels
2. Results
3. Project Design
4. Objectives
5. Audience
6. Background
7. Overview
8. Scope
9. Location
10. Time/duration
11. Message
12. Sector

Other categories mentioned in more than half the case studies include:

1. Organization/administration
2. Sponsorship
3. Evaluation

Nine categories were mentioned in less than half the case studies surveyed.

1. Cost
2. Dissemination
3. Staff
4. Timelines
5. Communication style
6. Research
7. Funding
8. Sources of information
9. References

Discussion

All the models outlined above were designed to describe specific projects. Herein lies both the strengths and weaknesses of each.

Since every model was developed for a particular project, its author(s) and developer(s) felt it to be the most appropriate. For other researchers, however, each model lacks something they believe should be included. An examination of the models indicates that there is general agreeement on the majority of steps which must be included. Most of these steps fall into a general theoretical description of the communication process (source, message, channel, receiver, and feedback[Berlo,1960]; who says what to whom with what effect[Lasswell, 1948]).

Differences among models stem largely from their point of origin rather than from radically divergent methods of case description. For example, the Diaz-Cisneros model (1977)was used to describe a relatively large scale agricultural development project; the Unesco model (1976) was used to study literacy projects; the Manandhar, et al. (1982) model was used to examine a forestry program. All the authors are united by a strong commitment to a complete case study description. However, since there is no standard description each author must originate a new model for a new case.

To overcome some of the limitations of the case study methodology, a generalizable framework for the descriptive phase of development communication case studies is suggested. Of course, generalization of findings depends on the concepts of validity and reliability. If a development communication case study has depicted what it purports to assess, the study can be said to be valid. And if independent observations of the situation would produce similar data, the study can be said to be reliable.

The proposed framwork offers a structure to more systematically describe development communication program in such a way that the case study could be replicated.

On the basis of this review, a case study model is now proposed which takes into account all the categories noted in the previous models. The proposed framework for developing a development communication case study is presented in Table 2.

Insert Table 2 About Here

Four categories have been added to the list which was derived from the analysis of the case study models. These four categories come from the literature of development communication (Bordenaue,1977; Bursusphat,1981; Maglalang, 1976; Woods, 1982,1983).

a. Name (1)--this is the development communication project name and acronym.

b. Pretesting (2)--this is a component of most models of media and message development While pretesting is not often reported, its inclusion in a case study might help other project developers learn processes and approaches to improving communication.

c. Formative evaluation (20)--this also is a part of most models of communication. If formative evaluation is done, the results should be reported.

d. Monitoring (21)--this is the implementation of the formative evaluation, which should detail what changes were made in the program as a result of its actual implementation in the field.

A minor limitation of this current work is that an N of 12 is somewhat small on which to generalize. While this may be true in an extreme experimental model, for the work in developing a case study framework, which is a heuristic device, the N of 12 seems large enough to be both reliable and valid, at this point. In a totally independent study which has recently surfaced, Harun, et al (1978), developed an outline for the case study of communication and information systems in developing countries (Appendix A). The case study categories chosen by these authors parallel the framework under discussion here, and in fact move case study methodology into a more analytical mode.

Summary

A 28 category framework for using the case study methodology to describe a development communication program has been presented. Work remaining to be done to further improve the case study methodology includes:

1. development of models and techniques for analyzing a single case study, and

2. development of techniques for aggregating case study data and then analyzing it.

The purpose of this model is to provide a systematic framework for describing a development communication case study. This framework does not intend to be a tool of analysis; it is, rather, descriptive. Analysis tools would have to be further developed.

Table 1: Case Study Category Matrix

CASE STUDY CATEGORIES

CASE STUDY	Location	Time	Sources of Information	Scope	Sponsorship	Funding	Background	Staff	Audience	Administration/ Organization	Objectives	Project Design	Results	Channels	Costs	Dissemination	Research	Evaluation	Timelines	References	Sector	Communication Style	Messages
Bordenave 1977	x	x	x	x	x		x		x	x	x	x	x	x		x		x	x		x		x
Boden 1979	x	x		x	x		x		x	x	x	x	x	x				x			x		x
Cuca & Pierce 1977	x	x			x				x	x	x	x	x	x			x				x		x
Cuyno 1977	x	x					x		x	x	x	x	x	x		x					x		x
Diaz-Cisneros 1977	x	x		x	x	x	x	x	x	x	x	x	x	x		x		x			x	x	x
Hall 1978	x	x	x	x	x		x		x	x	x	x	x	x				x			x		x
Leslie 1975	x	x		x			x		x	x	x	x	x	x	x						x		x
Manandhar, et al. 1982	x	x		x	x		x	x	x	x	x	x	x	x		x			x		x	x	x
Perrett 1982	x	x		x			x		x		x	x	x	x	x			x	x				
Sweeny & Parlato 1982	x	x		x	x		x		x		x	x	x	x	x	x	x	x		x	x		x
Unesco I 1976	x	x		x	x		x	x	x	x	x	x	x	x	x			x			x		x
Unesco II 1976	x	x		x			x	x	x	x	x	x	x	x	x			x			x		x

Table 2: Proposed Case Study Framework for Describing Development Communication Programs

Category	Description
1. Name	1. The name and acronym of the development communication program
2. Sector	2. The discipline in which the development communication program was undertaken, i.e., agricultural development, health education, forestry
3. Time/duration	3. The project's period of operation, i.e., the beginning and ending times
4. Location	4. The description of the location in which the project is implemented, i.e., country, regions
5. Scale/scope	5. A description of the size of the project, i.e.,national, regional, village, pilot, etc.
6. Sponsorship	6. A description of the organizations responsible for the sponsorship and implementation of the project
7. Funding	7. A listing of the monies put into the development communication project, allocated by year and category if possible
8. Background	8. A description of the origins, history of the problem, genesis of the organizational involvement and reason, and other relevant background factors
9. Administration	9. A description of how the development communication project is administratively lodged into a larger organization, including resources and division of labor
10. Objectives	10. A listing of the stated objectives or goals of the project and of the larger program

11. Audience	11. A description of the target audience(s) of the development communication project
12. Staff	12. A description of the relevent data and backgrounds of the major project staff and their roles
13. Project Design	13. A description of how the development communication project was organized to meets its objectives and a description of the planned activities for the project's development
14. Communication style	14. A description of the communication strategies in terms of message design approaches and channel selection approaches; a description of the way the message and medium are programmed to achieve the project goals
15. Messages	15. A description of the messages designed by the project for the target audience(s)
16. Channels	16. A description of the specific media employed in the communication effort
17. Materials	17. A description of the materials which were developed, i.e, flip charts which show planting calenders
18. Pretesting	18. A description of pretest strategies and results
19. Dissemination	19. A description of the diffusion and utilization strategies, i.e., messages and/or materials actually reaching the target audience(s) (media schedules, extension agent utilization)
20. Formative evaluation	20. A description of any formative evaluation activities that took place in the development communication project

21. Monitoring	21. A description of how any in-process changes derived from pre-testing, formative evaluation, or outside reviews were implemented
22. Results	22. A description of the planned and unplanned outcomes of the development communication project; descriptions of knowledge gains, practices, etc.
23. Costs	23. A description of the financial costs of the project, i.e., cost/ audience contacted, cost of buying broadcast time
24. Evaluation	24. A description of the results of any evaluations that were done
25. Timelines	25. A description of the month to month activities of the development communication project
26. Research	26. A description of the results of any research that occurred as part of the project
27. Sources of Information	27. A listing of the sources of information that allowed the case study to be written, i.e.,project reports, site visitations,brochures, interviews
28. References	28. A listing of any published or publically accessable references which describe the case study in any way

APPENDIX A:

DTCP GUIDELINES FOR PREPARING CASE STUDY*

1. Name of organization

2. Basic objectives and goals of the organization

3. Clientele served

4. General description of resources--budget, staff, areas covered, physical facilities, etc.

5. Existing internal and external communication policies within the organization and those external affecting the organization

6. Inventory of current communication activities for the following functions:

   6.1 Serving clientele
   6.2 Feedback from clientele for programme planning
   6.3 Management monitoring, control and coordination
   6.4 Technical (research) information reporting, processing and utilization
   6.5 Formulating overall policies and goals
   6.6 Staff development and relationships
   6.7 Gaining popular suppport and participation
   6.8 To and from other organizations

7. Inventory of communication resources

   7.1 Physical facilities--i.e. meeting rooms, training areas, libraries, data banks, etc.
   7.2 Equipment--i.e. telephones, computers, audio-visual, printing machines, mobile units, etc.
   7.3 Communication training given to staff
   7.4 Finances allocated to communication activities

8. Communication problems observed:

   8.1 Relevance of message content
   8.2 Timing
   8.3 Reaching the incorrect persons
   8.4 Misunderstanding messages by receivers
   8.5 Accuracy of information
   8.6 Responsiveness to feedback
   8.7 Volume of information (overload or insufficient)
   8.8 Appropriateness of communication channel/techniquie/media selected

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* Harun, R., et al., 1978. pp. 7-8.

9. Possible causes of these problems:

- 9.1 Communication capabilities of staff
- 9.2 Organizational structure
- 9.3 Communication policies
- 9.4 External pressures
- 9.5 Poor (or lack) of communication planning and strategy formulation
- 9.6 Availability of finances for communication activities
- 9.7 Physical facilities
- 9.8 Communication equipment
- 9.9 Sophistication level of message content
- 9.10 Sophistication level of channels/techniques/media used
- 9.11 Direction of information flows
- 9.12 Formal and informal channels misused
- 9.13 Perception differences between sender and receiver of message
- 9.14 Commitment to communication activities by top administrators
- 9.15 Language or dialect used

10. Recommend solutions or course of action for overcoming the problems

11. Executive summary of findings and recommendations

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Video as a Means for Analyzing Teaching: A Process of Self-Reflection and Critique

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Video as a Means for Analyzing Teaching:
Towards a Process of Self-Reflection and Critique

The interactive process of teaching/learning is a complex experience. Recent trends in studying teaching examine teaching behavior and its effects on student learning. Systems of codification of various teaching activities have been developed, and the analysis of teaching/learning continues and along with it the "need" for refining the process into more discreet activities linked with specific intended outcomes. This presupposes that teaching/learning can be reduced to measureable activities, corrected or reinforced upon proper identification. The more refined this process becomes, the more "scientific" the analysis.

In this paper I will argue that during the past two decades, research on teaching effectiveness can be identified within three differing paradigms: 1) the technical/"scientific"; 2) the humanistic; and 3) the person-centered paradigms. I will further argue that if we view teaching as an art or craft, and learning as an ever present process, rather than an "event," the real complexity of the teaching/learning experience can be clarified. To do this in a way different than the identification of discreet behaviors/outcomes, we will need to redefine the problems for analysis.

I will provide a theory-base, or rationale for extensive use of video in the analysis of teaching. My intention will be to clarify the theory-practice dilemma. I will suggest going beyond the use of microteaching as a form of analysis of discreet teaching activities. I will suggest going beyond an analysis of teaching through a process of self-reflection (reflective-teaching model-cf. Cruickshank, N.D.). I will propose a model for the analysis of teaching through a process of self-reflection and critique, based on the problem-posing, dialogic model of Paulo Freire (1970; 1971). This will require an extensive use of video with actual teaching/learning situations, and developing a framework for analyzing the teaching/learning process.

TEACHING EFFECTIVENESS RESEARCH

During the past two decades three distinctly different approaches to the study of teaching effectiveness have been established. The research currently dominating the field reflects a technical rationality. Research efforts receiving token attention cluster around what is commonly referred to as humanistic teaching. An almost totally ignored area of research can be appropriately labeled person-centered teaching. The assertion that research related to the study of teaching effectiveness can be classified as either dominant, token, or ignored is dramatized when one examines the Encyclopedia of Educational Research (1982) and finds only one (Combs, 1962) humanistic reference listed under the sections titled Teaching Characteristics (Ryan & Phillips, 1982), and Teaching Effectiveness (Medley, 1982). The references listed for these two sections are studies reflecting a technical model while person-centered teaching effectiveness research is not reported. Additionally, the reader will immediately recognize that most major educational journals devoted to reporting teaching effectiveness research have followed a similar posture over the past decade.

THREE RESEARCH APPROACHES[1]

Dominant Research: Technical

The majority of research on teaching effectiveness has focused on studies concerned with instructional methodologies and pupil achievement (Anderson, Evertson & Brophy, 1979; Fisher, Mariave & Filby, 1979; Good, Biddle & Brophy, 1975; Russell & Fea, 1963), teacher characteristics and teaching effectiveness (Brophy, 1979; Coker, Medley & Soar, 1980; Getzels & Jackson, 1963; Raskow, Airasian & Madaus, 1978), and teacher behaviors as related to pupil achievement (Good, 1979; Joyce & Weil, 1980; Rosenshine, 1976; Withall & Lewis, 1963).

Studies of teaching of this nature have followed a technical-political model based on a scientific, rational explanation of human behavior. This approach to explaining effective teaching performance suggests that the proper blending of techniques and content will significantly increase student performance. This positivistic attitude views teaching as a science/technology with identifiable, observable skills that are considered to be the "practice" of teaching. While I am willing to admit there are certain teching skills that can be taught and measured, I reject the notion that teaching is fundamentally comprised of the proper blend of techniques, methods, and skills.

The technical-rational model applied to teaching effectiveness suggests precise reasoning ("scientific accuracy") and predictability, and the nature of this model has an interest in control through management procedures. As the teaching profession has become an incresingly highly skilled technology with a primary emphasis on methods and outcomes, teachers have been rewarded for guiding their practice in ways that are amenable to this technology. As MacDonald suggests (1975), this notion implies that "teachers are potentially interchangeable," and leads to viewing productive activity as something learned and performed "mechanistically." Thus, any "good" teaching activity can be produced by any other teacher, and "all productive teaching is measureable in terms of the criteria of the accountability in use (pp. 79-80)."

Apple (1982) refers to this as a process of "deskilling-reskilling" the teacher:

> As the procedures of technical control enter into the school in the guise of pre-designed curricular/teaching/evaluation 'systems', teachers are being deskilled. Yet they are also being reskilled in a way that is quite consequential. . . . while the deskilling involves the loss of craft, the ongoing atrophication of educational skills, the reskilling involves substitution of the skills with ideological visions of management (p. 256).

Tom (1977) contends that what is lacking in the managerial perspective is acknowledging interpersonal, or social relationships:

> . . . these relationships cannot be reduced to a collection of techniques without debasing them and stripping them of their humanity. However, even if one rejects this humanistic concern, there is another fundamental problem. A technology must have definite ends toward which its activity is aimed. There is, of course, no long-term consensus on the aims of education (p. 38).

The lack of consensus on the aims of education within the technical model is not viewed as problematic because there are commonsense understandings of purpose within the model. The position here becomes one of value-neutrality, i.e. teaching and learning as apolitical.

Token Research: Humanistic

Running concurrently with the evolution of technical rationality as a base for studying teaching effectiveness have been research efforts reflecting a humanistic model. This movement is receiving little more than token attention (Peter, 1977; West, 1972). Research studies sensitive to the human aspects of the teaching-learning experience have included teacher expectancy studies (Davidson & Lang, 1960; Rosenthal & Jacobson, 1969). The process of perceiving which precedes expectations is unique to each individual. Bruner (1958) contends that humans tend to maintain in consonance of their opinions, ideas and attitudes. Individuals, therefore attempt to minimize surprise by imposing a subjective consistency upon their environments

The psychological credibility of the self-fulfilling phenomenon is perhaps one reason that research has continued despite the failure of Rosenthal and Jacobsen to provide totally convincing evidence (Braun, 1973). Neither Snow (1969) nor Thorndike (1968) deny the fact that techer expectation may be a powerful force. Additional impetus has been provided by studies lending support to that phenomenon (Brophy & Good, 1970; Mendoza, Good & Brophy, 1971).

Interpersonal relationship studies and writings by Aspy and Roebuck (1980, 1982) Combs (1969) Dieken and Fox (1973) and Peterson (1979) can also be classified as humanistic literature currently receiving only token attention. After a review of the literature, Hamachek (1969) states that effective techers appear to be those who are human in the fullest sense. They have a sense of humor, are fair, empathic, more democratic than autocratic and are able to relate easily and naturally to students on a one-to-one and group basis.

Research relative to learning climate (Anderson & Walberg, 1967; Combs, 1982; Dobson, Grey & Dobson, 1979; Sinclair, 1968) seem to point out the need for caring, understanding, openness, acceptance and genuineness. Rogers (1983) calls attention to the significance of research being done from a humansitic perspective when he states:

> . . . this research provides convincing evidence--from two teams based on two continents--showing that studetns *learn more*, *attend school more often*, are *more creative*, *more capable of problem solv-*

> ing, when the teachers provide the kind of human, facilitative climate that has been described . . . (p. 197).

Aspy and Roebuck (1983) further support Roger's statement when they submit that their findings can be summarized with one statement:

> . . . students learn more and behave better when they receive high levels of understanding, caring, and genuineness, than when they are given low levels of them (p. 199).

Ignored Research: Person-Centered

While these two distinctly different research approaches to the study of teaching effectiveness have been occurring, a third and almost totally ignored area of research also is being conducted. This seemingly ignored research effort can be labeled as person-centered.

Beginning with Dewey (1910, 1964) there has gradually emerged a group of educators who have come to view a teacher's philosophy as the basis for their decisions about the educational process. Dewey believed that humans are in a state of change and that goodness resides in them. The significance of Dewey's thesis is amplified by Friere (1981) when he states, "Our pedagogy cannot do without a vision of man and the world" (p. 338).

There is ample evidence to suggest that relatively few teachers have developed internally consistent philosophies, i.e., teching behaviors that are in accordance with their professed beliefs (Brown, 1968; Kessinger, 1979; Wright, 1980). Marshall (1973) contends that teachers proceed with an eclectic approach comprised of bits of data from diverse psychological and philosophical camps.

Considering this state of the art, it seems that a more systematic treatment of teacher beliefs-practice congruency relative to instruction would be useful. Wiles and Bondi (1979) suggest that educational philosophies are the heart of purposeful activity. They contend that because teachers are confronted with multiple choices for schooling the young, it is vital that teachers understand their own values and beliefs about schooling.

Morris (1966) states:

> A limit contingent of educators who have come to see the philsophical and educational problems as continuous has emerged. Philosophy and education are really two aspects of the same undertaking . . . the forming of those fundamental dispositions toward nature and our fellow man which the world demands of us. This has led to a going beyond educational aims and strategies to examine the relevance of a person's philosophical thinking in curriculum design, teaching methodology, and other areas such as administrative policy-making (p. 76).

Since teachers play a significant part in determining the educational environment, it is important to know something about their assumptions relative to the nature of humans. Wrightsman (1964) contends that the assumptions one holds about what people are really like influence one's interactions with others. Kelley and Rasey (1952) point out that teachers' basic beliefs about the nature of humans help to define their relationships with students. Combs (1962, 1982) further emphasizes the importance of a person's basic beliefs about the nature of humankind and the influence of this phenomenon upon human interaction in the educational process.

Social scientists have come to realize that people's assumptions about the nature of humankind can be conceptualized and measured, and it can be determined if these beliefs influence behavior toward others. Wrightsman (1964, 1974) developed an instrument for measuring people's beliefs about the nature of humankind, the Philosophies of Human Nature Scale (PHN). Research using the PHN has been conducted in the area of making judgements of specific persons, belief differentiation among occupational groups, sex, family background, religious preferences, authoritarianism and attitude change, children's perception of the educational environment, non-verbal communication patterns, verbal-nonverbal congruency in the classroom, moral development, and pupil control ideology (Childress & Dobson, 1979; Deal, Dobson & Dobson, 1982; Dobson, Hopkins, & Elsom, 1973; Dobson, Sewell & Shelton, 1974; Mason, 1966; Wrightsman, 1974). These studies have attempted to identify and measure certain basic beliefs about the nature of humankind and have contributed normative data to the problem of interpersoanl aspects of humans. Therefore, the results of this literature emphasize that the basic beliefs one holds about the nature of humankind comprise a viable force in the structuring of reciprocal interactions among people.

Inherent in a teacher's personal philosophy are assumptions about the purposes of schooling, the nature of knowledge, a view of society, and the person's position within that society. These views have an effect on what a techer does in the classroom. How teachers organize curriculum, evaluate students, interact with students, and view themselves within the teaching-learning context are all affected by the basic philosophical orientation they bring to the classroom. Zeichner's (1979a, 1979b, 1980, 1981) research on the student teaching experience, teacher socialization and reflective teaching provides a rationale and direction for further research and also falls within the person-centered approach.

My bias support the need to go beyond the scientific-technical-rational studies of teaching effectiveness and examine more closely the humanistic and the person centered approaches. This does not negate the need for empirical-statistical analysis to the teaching/learning context. This does not deny that there exists a set of teaching "skills" that may enhance the teaching/learning process. Microteaching and the Reflective-Teaching Model (Cruckshank, N.D.) are able to provide the tools for the refinement of and an analysis of these skills. Yet the humanistic and person-centered paradigm for studying teaching effectiveness identify a more complex array of variables that do not lend themselves to statistical analysis. Hence the need for alternative means of looking at the teaching/learning process.

RESEARCH METHODOLOGY

To conduct research within the humanistic and person-centered paradigms will demand alternative research methodologies. Elsewhere I have argued for, and provided a rationale for utilizing alternative conceptual frameworks and the implications these alternatives would have for the field of instructional technology (Koetting, 1979, 1981, 1983, 1984a, 1984b). I drew heavily on the work of Jurgen Habermas 91971) and Paulo Freire (1970, 1973). My concerns remain the same, i.e. the need to focus our attention on epistemology and philosophical conceptions of the process of schooling.

Codification

To arrive at an interpretive or critical understanding of schooling (epistemological issues), we will need to question (pose as problematic) our common-sense notions of schooling. This can be done through an extensive use of video-taping within actual classroom settings.

Instead of using video within a micro-teaching and self-reflective teaching model of analysis, video-taping should occur during entire class periods, over an extended period of time. This video-taping process constitutes Freire's notion of codification (1970). Codification consists of re-presenting the object of reflection (in this case, the classroom teaching experience) to the subjects (teachers/students), in a form identifiable to them, and related to their experience. For example, Freire used photographs and drawing's depicting the existential situations of the people with whom he worked. The visuals used were familiar to his subjects because they contained situations and events based on the subject's own descriptions of their life-situations. These codified visuals become the objects that mediate the subjects in their critical analysis (decodification). The codifications become "cognizable objects, challenges towards which the critical reflection of the decoders should be directed" (Freire, 1970, p. 107). The cognizable objects, visual re-presentations of the subjects in life-situations, posed as problems to subjects, depict the situationality of the subjects. Self-reflection upon this situationality is reflection about the very "condition" of existence, namely, "critical thinking by means of which men discover each other to be 'in a situation'" (Freire, 1970, p. 100). When this situation, or context, is seen as an "objective-problematic situation", subjects reach the stage wherein the ability to intervene in their self-formative, historical context becomes a possibility.[2]

This process of codification will keep us focused on the person of the teacher (beliefs-practice, self-reflection on the self-formative process-person-centered paradigm) and allow us to use classroom settings "as is" for data gathering. We will then use Freire's theory of dialogics in decodifying the individual teacher's/student's[3] understanding of the schooling context.

Theory of Dialogics

Freire's theory of dialogics can be most effectively examined through naturalistic inquiry. Dialogue is the 'encounter between men mediated by the world, in order to name the world" (Freire, 1970, p. 76). There are certain conditions required of subjects who enter into dialogue:

1. a profound love of individuals
2. humility
3. an intense faith in man (this is an _a priori_ faith in the person)
4. trust (established through dialogue)
5. hope (rooted in the person's incompleteness, and recognition of that incompleteness; constant search)
6. critical thinking (Freire, 1970, pp. 78-82).

These requirements demand total commitment to the process of dialogue from those who choose to enter the dialogic relationship. They are neither naive nor unworkable. They become, for subjects engaged in emancipatory praxis, a basic orientation to life.

The term critical thinking, as a necessary element in dialogue, needs to be pursued and delineated further. Critical thinking is thinking which

> discerns and indivisible solidarity between the world and men and admits of no dichotomy between them -- thinking which perceives reality as process, as transformation, rather than as static entity -- thinking which does not separate itself from action, but constantly immerses itself in temporality without fear of the risks involved. Critical thinking contrasts with naive thinking, which sees 'historical time as a weight, a stratificatin of the acquisitions and experiences of the past,' from which the present should emerge normalized and 'well-behaved.' For the naive thinker, the important thing is accomodation to this normalized 'today.' For the critic, the important thing is the continuing transformation of reality, in behalf of the continuing humanization of men (Freire, 1970, p. 81).

Dialogue requires critical thinking and is capable of generating critical thinking. Communication is based on dialogue, and education is based on communication. Communication is concerned with meaning, understanding. Concern for meaning and understanding centers our efforts within the humanistic and person-centered paradigm for research.

This process of dialogue identifies the power relations within the classroom. Shared responsibility for what goes on is vitally important. The dialogue focuses on "what do we want to happen in here, what is actually happening in the classroom," and "what are the possibilities for individuals to affect change in their daily lives."

Decodification

The process of decodifying an individual techer's/student's understanding of the schooling context consists of teacher-student, students-teachers reflecting critically (dialogics) on the mediating object (in this case, the video-tape of their classroom situation), thus externalizing their understandings of, and consequently making explicit their "real consciousness" of the schooling situation. During this time, through dialogue, interpretations are challenged and understandings questioned, constantly posing the object of discussion as problematic. Through this process of consciousness raising, subjects can arrive at a greater awareness of the social context which forms their lives, and also create awareness of their capacity to intervene and transform it (*cf*. Freire, 1970, pp. 100-108).

The process of decoding the mediating objects under analysis thus consists in investigation of the subjects' thinking concerning their life-situation. Personal understandings become educational. At the same time "all authentic education investigates thinking" (Freire, 1970, p. 101). Investigating the subjects' thinking leads to further investigation, hence education and personal understanding are "simply different moments of the same process" (Freire, 1970, p. 101).

When subjects begin to make explicit their views of the world, they begin to see how "they themselves acted while actually experiencing the situation they are now analyzing, and thus reach a 'perception of their previous perception'" (Freire, 1970, p. 108). Achieving this awareness, reality is perceived differently: "By broadening the horizon of their perception, they discover more easily in their 'background awareness' the dialectical relations between the two dimensions of reality." Thus the process of decodification brings about new perceptions and the development of "new knowledge" (Freire, 1970, p. 108).

The framework within which the decodification process could take place would be philosophical in nature, i.e. concerned with the theory/professed theory of the teacher (beliefs/practice). Analysis of the philosophical base of the teacher regarding beliefs about learners, the purpose of schooling, the notion of knowledge, what is of value, the nature of social relations within the classroom, etc., could all be areas for analysis. What it is teachers/students say regarding schooling, and what they actually do can be dramatically re-presented to them through video-tape. If there is discrepency, it will become evident (level of awareness), and although a changed or more informed praxis cannot be guaranteed, the opportunity for positive change is present. In short, this form of analysis would allow us to explore the culture of a particular classroom, and would keep us directly within the person-centered paradigm of teaching effectiveness.[4]

CONCLUSION

There are valid alternative frameworks for analyzing school problems/issues. I believe it to be in the interest of the field of instructional technology to broaden its theory-base and explore other literature within education and to integrate different theory/practice within our conceptualizations of the field. Different frameworks for defining the process of schooling ask different questions for research. The field of instructional technology has much to offer the general field of education. The research potential is great.

FOOTNOTES

1. This section of my paper on Teaching Effectiveness Research comes from chapter five "Teaching Effectiveness Research: Implications for Professional Development", in the book Looking At, Talking About, and Living with Children: Reflections on the Process of Schooling, by Russell L. Dobson, Judith E. Dobson, and J. Randall Koetting (in press, fall, 1985).

2. Freire's Education for Critical Consciousness (New York: The Seabury Press), 1973, gives examples of visuals used in the codification process. For a detailed discussion of the codification/decodification process, see Freire's Pedagogy of the Oppressed (New York: The Seabury Press), 1970, chapter three.

3. Freire's notion of "teacher-student with students-teachers" suggests the shared responsibility that exists within the classroom setting. The teacher is student, and the students are teachers. This is not a problem of semantics, but a reality. We learn from each other.

4. I believe Elliot Eisner's (1979) notion of educational connoisseurship/educational criticism is important here. See also Dobson, Dobson and Kessinger (1980), who propose a model for Staff Development that examines an individual's philosophical beliefs and teaching practice.

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EFFECTIVENESS OF INTERACTIVE VIDEO TO TEACH CPR THEORY AND SKILLS

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Abstract

This study sought to determine if an interactive video system of instruction taught CPR (cardiopulmonary resuscitation) as effectively as traditional instruction. Using standards of the American Heart Association, the study was designed with two randomized groups to be taught either by live instruction or by interactive video. Both groups were taught theory and skills of basic life support including single rescuer (heartsaver), two rescuer, obstructed airway and infant rescuer. Following instruction and practice, separate CPR evaluators tested individuals from either group without knowing the type of instruction they had received. For both the written test and the performance of heartsaver skills on the first attempt, there was no significant difference between traditional CPR instruction and instruction by interactive video. Additionally, the interactive video system taught obstructed airway in basic life support better.

EFFECTIVENESS OF INTERACTIVE VIDEO TO TEACH CPR THEORY AND SKILLS

This study was initiated in response to a request by the American Heart Association to validate if an interactive video system of CPR instruction taught as effectively as traditional instruction. The rationale for development of the interactive video system was based on the need for greater availability of CPR instruction. No matter how extensive campaigns have been to train instructors, approximately the same number of individuals enter as instructors each year as the number leaving. The demand for CPR courses has often been greater than their availability (Nelson and Brown, 1984). Chances against having a trained CPR rescuer in the United States have been 18 to 1 (Hon, 1982). To provide a supplemental means of instruction, a mediated format was sought with the aid of instructional technology. An effective system of instruction could be applied to round out public and professional needs for CPR instruction.

Background

The value of training large numbers of individuals in CPR skills is well established. Mortality statistics and their circumstances support large scale CPR instruction in populations. Annually, about 640,000 persons in the United States die from ischemic heart disease and approximately 350,000 of these occur outside hospitals (White, 1982).

The majority of cardiac arrests occur in the home (St. Louis, 1982) making evident a need for family members and others to have CPR background to draw upon in the event of an emergency. Even with effective community services, prompt CPR efforts by those at the scene could make a great difference in the condition of victims of arrest and unconsciousness.

Across the country, communities vary in their ability to handle emergencies and to instruct residents in CPR. Cost is always a factor and people have to be motivated to take time out of busy schedules to prepare for an emergency that they may never face. Professionals are in a position to identify and influence target groups about CPR instruction and to implement a practical plan. Sousa (1982) reported an organized approach used in the Connecticut school system. CPR and first aid instruction were incorporated into the working day of teachers and staff. Cost included the salaries for nurses who provided the instruction, salaries for substitute teachers so that the regular teachers could be released, and cost for materials. St. Louis (1982) reported another target group in Washington. Physicians were surveyed to determine their CPR recommendations for spouses of heart patients. Findings showed that only 40% of physicians interviewed recommended CPR instruction for spouses. Physician education, ease of access to instruction and being able to fit the instruction in with job schedules may be influencing factors.

With the need for readily available CPR instruction apparent over the years, a variety of self learning and media augmented strategies have been devised.

Strategies of Instruction

Research reports of CPR instruction have compared the effectiveness of teaching strategies on cognitive and skill performance and have also looked at retention of knowledge and skills over time. Safar et al. (1981) reported a study initiated in 1973 in which adolescents were taught CPR through live instruction, a self training system, repeated film viewing without manikin practice, and the self training system with film viewings. The self training system taught as effectively as live instruction and better than repetitive film viewing. The self training group was tested for skill performance at 3 and 12 months post instruction with a decline to 50% or less of students passing skills by 12 months. In another study (Gombeski, Effron, Ramirez and Moore, 1982) participants completed either an eight hour, 3 session course or a four hour single session course and were tested for cognitive and skill retention after one year. While skill performance was below certification level for both groups at one year, knowledge and skills were significantly higher in the longer trained group. Friesen and Stotts (1984) compared retention as a result of CPR instruction by lecture demonstration - return demonstration and a self learning method that included use of slides, audiotapes and programmed instruction workbooks.

By eight weeks post instruction, both groups demonstrated cognitive knowledge at a mastery level. Skills were below mastery in both groups.

Additional course descriptions using media have been reported in the literature. DeBaca (1983) described a CPR course offered to hospital employees that incorporated the use of slides and audiotape followed by live instructor demonstration and return demonstration. After a five month trial period, the course was evaluated favorably. Rehm (1983) reported the effective use of a videotape on CPR as part of instruction given to parents whose baby had been hospitalized. The abundance of strategies using media to teach CPR over the last decade and longer, suggests wide acceptance that mediated instruction particularly with a self learning/pacing component may help with existing needs for effective CPR instruction.

CPR Interactive Video

With recent technological advances, exploring how technology could further facilitate CPR instruction was a natural next step. In 1981, Hessinger reported a computer and video instructional system developed by David Hon of the American Heart Association and other specialists. The technical features combined a Sony LPD-1000 laser optical videodisc player, two monitors, a random access audio machine, an adapted Apple II computer and adult and infant Laerdal manikins wired with sensors to detect key CPR skills.

The videodisc was selected over videotape because of its rapid random access capability. Needed pictorial information could be displayed without delays that might interrupt the learner's concentration. Immediate feedback could be provided to reinforce pertinent information.

The audiotape device was engineered to avoid having to contain sound on the videodisc during freeze frames. The videodisc does not play or record sound unless the disc is running. When sound accompanies a still picture about 400 video frames are used up every 15 seconds. Because so many still pictures were needed for the large program, no disc space could be wasted. Hence a random access audio recorder was created (Hon, 1982). The CPR instructional design for the software included key elements of instruction that would be given in a live situation such as: (1) attention gaining measures, (2) orientation to the instructional setting, (3) definition of terms, (4) organization of presentation related to objectives, (5) practice opportunities, (6) redundancy strategies, (7) motivators and (8) evaluation components.

Theoretical Framework

Systems theory as described by Von Bertalanffy (1969) and Hazzard (1971) can serve as a basis for looking at CPR and CPR interactive video instruction. With the underlying assumption that man is an open system, man's openness can be facilitated through CPR techniques. The victim of cardiac arrest, for example, becomes unable to circulate (throughput) needed blood supply.

With stoppage of respirations, life sustaining oxygen rich air (input) cannot come into the system. Carbon dioxide cannot be exhaled (output) from the system. A rescuer (second system) provides behaviors (output) through compressions and ventilations etc. to assist the victim's system operation. Resumed breathing or appearance of a pulse in the victim would represent examples of feedback to the rescuer.

When learning via interactive video, the learner as an open system acts on the closed system of hardware and software rendering it open (A videodisc-based course, 1983). The learner's behaviors (output) with the turn on switch and light pen to activate the menu of topics, initiate the openness. In addition, just as rescuer acts on a victim's system, the learner-rescuer acts on an adult or infant manikin's system made possible by sensors and interrelated connecting parts. Feedback elicited through the sensors and presented visually on the monitors, or by sound or touch, permits the learner to determine if the objective to be learned has been attained. For example, when being instructed, if hand placement for compressions is correct, the information appears on the monitor and a specific tone is sounded. During CPR testing, these feedback clues are withdrawn to more closely simulate an actual rescue. After testing feedback is given.

Procedure

When the CPR interactive video prototype was completed, the American Heart Association requested a validation study to be done and it was carried out at a middle atlantic baccalaureate school of nursing. The American Heart Association set forth these requirements: (1) Study population would have no prereading, had never been certified and had some basic education level, (2) instruction would run six hours maximum and might be given in two segments, and (3) instructors at the national office of the AHA would not be involved in evaluation. The evaluation requirements included these: (1) Evaluation to be given immediately after classes, (2) Evaluation to be conducted by three evaluators who were CPR instructors but who did not give the instruction, (3) Evaluation would be made of first efforts at performance, and (4) The final number certified on first performance would be recorded.

Method

The present study was designed to examine the learning outcomes from CPR interactive video instruction as they compared to outcomes from conventional instruction. The critical question was, could the interactive video system instruct as effectively as live instruction. In accord with American Heart Association standards, two comparison groups of students with fifty students in each group, were planned and implemented. Fifty students of similar educational background were to take the interactive video course singly or in groups of three. Another fifty were to have live instruction.

Separate evaluators who were to be CPR instructors but did not instruct this population, were to test students from either group without knowing their mode of instruction. The reason why it was important to look at first performance was to examine the effectiveness of instruction at the same point for both types of instruction. For individuals who had unsuccessful first attempts, additional assistance would be offered because rescue skills need to be mastered in order for a person to give effective help to a victim of an actual emergency.

A core team consisting of a project director (P.D.) and a research assistant (R.A.) worked cooperatively to obtain and schedule the sample populations, arrange for CPR instructors and evaluators, and provide places for instruction. The research assistant was a certified CPR instructor but did not give instruction or conduct testing during the study. The R.A. was present when students learned with interactive video and provided minimal assistance when needed to overcome a technical snag in the system. As an illustration, when a sensor did not work in the prototype manikin, the R.A. helped. This happened on a few occasions as when the temporary landmark notch sensor became unglued, the R.A. showed the correct location or when the finger sweep sensor did not work in the obstructed airway section, the sweep was observed. The P.D. managed research events with time lines, established data strategies for analysis and drafted a report for the American Heart Association.

The population samples in the study consisted of students, primarily in the young adult years between 18 and 20. There were less than a dozen learners between 20 and 50. Most of the learners were nursing students. The remainder were pharmacy students or other university students. Two CPR instructors taught in the live instruction situation and three evaluators tested students. The instructors and evaluators had been certified by the American Heart Association. Between September 1982 and April 1983, 48 participants received basic life support CPR instruction by interactive video and 51 by traditional teacher taught instruction.

Students were scheduled in such a way that the time for CPR instruction would not conflict with course related demands in their schedules. CPR was not scheduled during major test times such as during mid term or final examination periods. It was also not scheduled during the holiday periods such as Thanksgiving and Christmas when many students would be away. Individual changes in scheduling had to be made from time to time due to illness or other reasons. When students cancelled appointments, they were rescheduled. In the live instruction situation, not all students were able to return for the second session at the same time. Seven students who took the first session did not return for a second session. There were seven live instruction situations given. Each of these consisted of two sessions roughly a week apart and testing was conducted immediately after the second session. The average class size was 6.43 students for each instructor with a range from six to eight.

For the interactive video system, students were scheduled individually and in small groups. Not all students were able to return for the second session and had to be rescheduled. Some students who completed the heart saver segment singly, were scheduled at their request with a group to complete the other components of basic life support because the time agreed with their individual schedules. There were times when the system malfunctioned and although it was serviced promptly students had to be rescheduled.

Of the forty eight students who completed CPR instruction on the system, approximately four fifths finished as part of a group of two or three students. An additional two did not return after the first instruction. Students on the system finished instruction at different times singly, in pairs or in groups of three. Arrangements were made for testing when approximately six students were ready to be evaluated. The space of days between learning and testing differed for students with an average time of 5.60 days between completing CPR instruction and being evaluated.

Results

For skills, using a 2 tail test with an alpha error equal to .05, the null hypothesis for each of these tests may be stated as follows: There is no significant difference between the proportion of individuals from the interactive video group and the proportion of individuals from the traditional group who passed the test.

Tests were done to determine if skill level differences existed for heartsaver, which emphasizes a single rescuer, and for basic life support which consists of skills required for single rescuer, two rescuer, obstructed airway and skills to be performed on an infant. These were followed by testing individual skill components of BLS. The statistical results beginning with heartsaver are shown in Table 1.

Table 1

Z Test for Basic Life Support Components

	INTERACTIVE VIDEO (N=48)		TRADITIONAL (N=51)		
COMPONENT	% PASSED	% FAILED	% PASSED	% FAILED	Z
Single Rescuer (Heartsaver)	60.42	39.58	41.18	58.82	1.95
Two Rescuer	68.75	31.25	57.78	42.22	1.14
Obstructed Airway (Conscious)	87.23	12.77	71.11	28.89	2.04*
Obstructed Airway (Becomes Unconscious)	86.96	13.04	53.33	46.67	3.96*
Obstructed Airway (Found Unconscious)	81.25	18.75	51.11	48.89	3.35*
Infant	43.75	56.25	56.82	43.18	-1.32
Obstructed Airway (Infant Conscious)	70.21	29.79	79.55	20.45	1.54
Obstructed Airway (Infant Unconscious)	68.09	31.91	64.44	35.56	.39

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* Significant at 1.96

Statistical tests were performed on individual skills within the basic life support instruction. Table 1 shows significant difference in situations of an obstructed airway of the conscious adult, becoming unconscious and when found unconscious. In these instances more skills were passed on first attempt by students who learned on the interactive video system. The rejection region for $\alpha = .05$ is $Z \geq 1.96$ or $Z \leq -1.96$. Using classical analysis, the hypothesis for heartsaver cannot be rejected and it must be concluded that there is no significant difference between students taught by the interactive video method and those taught be traditional instruction.

For basic life support, the hypothesis is rejected for an $\alpha = .05$ and it may be concluded that a significantly greater proportion of students taught by the interactive video method passed basic life support on the first testing than did students taught by traditional instruction.

In the knowledge section, all students completed a paper and pencil written examination. The same set of 50 multiple choice questions drawn from the American Heart Association questions were answered by both groups. Mean scores were as follows: For the interactive video group 84.35 and the traditional group 82.76, no sign. dif. at $\alpha = .05$ (sign test $z = 1.75$).

Based on theory and skill scores, it can be concluded that for both the written test and the performance of heartsaver skills on the first attempt, there was no significant difference between traditional CPR instruction and interactive video. Obstructed airway was taught better by interactive video.

Summary

This was a study to determine if interactive video could teach CPR as effectively as traditional instruction. Groups of randomly assigned individuals were taught using the two methods. Results showed that no significant difference existed between interactive video instruction and traditional instruction in both skills and knowledge with the exception of obstructed airway in the adult. The interactive video system taught skills for obstructed airway in the adult significantly better. The implication is that a technological means of instruction such as interactive video can be a valuable adjunct in helping to meet present demands for CPR courses. Future research is planned and will reflect this baseline research to validate the system. Variables such as learner differences, time and retention factors, cost factors as well as diverse content applications for interactive video need to be addressed further. In the present study it took approximately 6 to 8 hours for basic life support in both groups including certification. Discovering influencing variables related to time should be pursued. Retention studies need to focus on both cognitive and skill areas. Affective responses need also to be examined.

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Randall R. Molina

THE EFFECTS OF SELECTED VARIABLES ON LEARNING A SPATIAL VISUALIZATION TASK: A REPORT OF RESEARCH IN PROGRESS

This paper describes a systematic research program that has been designed to study the cumulative effects of selected instructional variables on learning a spatial visualization task. The three studies described in the paper are "in progress", they have not been completed.

Background:

Higgins developed a self-instructional programmed text to teach Air Force cadets to read aircraft instruments and identify pictures of aircraft in the positions indicated on the instruments. A sample item from the criterion test used to assess the effectiveness of the instructional program is presented in figure 1. The instructional program included directions for reading the instruments and practice/feedback on identifying aircraft in the positions indicated on the instruments. The program was highly effective when used with the all male ROTC cadets for whom it was designed. Cadets who participated in the field test on the program had mean percentage scores of 53% correct on a nine-item pretest and 87% correct on a 36 item posttest (Higgins, 1975).

In 1983 Higgins adapted the Aircraft Instrument Comprehension program to a slide-tape presentation. The slide-tape program included the same direct instruction and practice used in the programmed text. The instruction in the slide-tape program is presented orally at a fixed pace with no opportunity to review information once it is presented. The slide-tape version of the AIC program has been presented to several groups of students, mostly females, enrolled in teacher education programs at Arizona State University. Mean percentage scores for these groups on a 10 item pretest have ranged from 33% to 34% correct. Mean percentage scores for the groups on a 20 item posttest range from 63% to 68%.

The studies that follow are designed to identify instructional variables that will improve the performance of female students on the AIC test.

Study 1

Joellyn Pollock

Problem Statement:

This study is designed to determine the individual and combined effects of two different perspectives (subjective and objective) and two different sequences (attitude first or heading first) for presenting cues in the Aircraft Instrument Comprehension program. It is hypothesized that presenting cues that start from the learner's subjective point of view (zero degree camera angle) and progress to an objective point of view (45 degree to 180 degree camera angle) will be the more effective procedure for naive learners learning to read aircraft instruments.

Background:

Gibson's (1947) studies of the use of line drawings with distortions of distinctive features to teach aircraft identification and his use of zero angle (subjective point of view) to teach gunnery skills to aviation cadets is an early effort to understand how audiovisual techniques can be used to present effective instructional cues. Roshal (1949) demonstrated the superiority of zero degree camera angle (subjective view) over a 180 degree camera angle (extreme objective point of view) for presenting cues needed to perform a knot tying task. This study extends the previous research to a complex spatial visualization task.

Methods:

Subjects:

Female elementary education majors enrolled in IME 411 in the Department of Educational Technology will serve as subjects.

Materials:

Four versions of Higgins' AIC sound-slide program will be produced for this study. In the first program, the learner will be oriented to read the instruments from "inside" the aircraft pictured (subjective orientation). In this program, the attitude indicator will be presented first because it can be read from a subjective orientation without having to mentally rotate the aircraft pictured; then the heading indicator will be presented. The second program will combine the subjective oriented cues with a heading then attitude sequence. The third program will combine objective oriented cues (cues oriented from outside the aircraft) with an attitude then heading sequence. Storyboard samples of the four programs are presented in Figure 2. The fourth program presents objective cues with a heading then attitude sequence.

Procedures:

A posttest-only control group experimental design will be used. Subjects will be randomly assigned to one of the four treatment groups. Each group will meet separately to view their version of the instructional program. The criterion test will be administered at the conclusion of the instructional program. Subjects' posttest scores on the AIC test will be analyzed using analysis of variance (ANOVA) procedures.

Study 2
Kimberly Koenigs

Problem Statement:

This study is designed to examine the effects of pre-instruction on performance of a spatial visualization task. Pre-instruction will be used to familiarize participants with the features (front, back, right/left sides) and rotations (pitch, bank, and heading) of an aircraft.

Background:

Two studies have been identified which directly relate to the hypothesis that use of a pre-instructional program will significantly raise the scores of naive learners on the AIC criterion test. Ives and Rakow (1983) found that when children use pictures to solve rotation tasks and are required to rotate objects with inherent feature descriptions, their performance is significantly lower than when objects with inherent features are used or when language, which supplies a feature description, is used. Seddon, Eniaiyeju, and Jusoh (1984) found that remedial instruction which made use of concrete models, shaded diagrams and simple media animation techniques were effective in teaching Nigerian students (predominantly teenage males) to identify chemical molecules in various positions of rotation.

Methods:

Subjects:

A sample group of 150 undergraduate college students will participate in this study.

Materials:

A series of slides will be prepared to present, in split screen format, instruction, practice, and feedback relating to perspective aircraft features and rotations. An audiotape will supplement the slides by providing oral instructions, prompts, and feedback related to the illustrations of aircraft presented.

Procedure:

A posttest-only control group experimental design will be used. The experimental group will be presented pre-instruction, the AIC program, the AIC posttest, and an attitude questionnaire. The control group will be presented the AIC program, the AIC posttest, and the attitude questionnaire.

The AIC posttest scores will be statistically analyzed using analysis of variance (ANOVA) procedures. Response to the attitude questionnaire will be analyzed to determine if students found the pre-instruction to be helpful in performing the AIC task.

Study 3

Randall R. Molina

Problem Statement:

This study is designed to determine the effectiveness of imagery instruction on learning a spatial visualization task. The effects of visualization demonstration and visualization practice on learner posttest performance will be examined. The differential effectiveness of the imagery strategy for subjects with high and low visual ability will be determined.

Background:

Seddon, Eniaiyeju, and Jusoh (1984) investigated the effects of visualization instruction on learning to identify illustrations of chemical molecules in various positions of rotations. Subjects who received instruction in visualizing the effects of rotation performed significantly better on a Rotations Test than a comparison group. They also determined that a 10 degree stepsize using dissolves between slide changes was significantly more effective than larger stepsizes and abrupt slide changes.

Methods:

Subjects:

The sample will consist of 120 undergraduate education majors enrolled in an Instructional Media Education course randomly assigned to one of four treatment groups.

Materials:

The materials will consist of a series of slides which (a) demonstrates how to use a four-step procedure to construct a mental image of an aircraft in the position indicated on aircraft instruments, and (b) provides practice using the four-step visualization procedure. The visualization instruction will be embedded in the most effective version of the AIC program produced in the previous two studies. Treatment combinations of visualization demonstration and practice will be prepared. Two levels of visualization demonstration (presence and absence) and two levels of practice (presence and absence) will be completely crossed.

Procedures:

The Cards Rotations Test will be administered prior to initiating the experiment. Subjects will view the AIC program then complete a twenty-item criterion posttest and a brief questionnaire. A Posttest-Only 2 X 2 factorial experimental design will be used. Figure 4 illustrates the experimental design. A univariate analysis of variance will be performed to determine the individual and combined effects of demonstration and practice on posttest scores. Data from the spatial visualization ability test and the post-instruction questionnaire will be correlated with posttest scores. A significant difference is expected for confirmation of the hypothesis that imagery instruction which includes both visualization demonstration and visualization practice can improve learner posttest performance on a spatial visualization task.

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Field Independence-Dependence, Multiple and Linear Imagery in a Visual Location Task

by

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A paper presented at the national convention of the Association for Educational Communications and Technology, Anaheim, CA, January 19, 1985.

The purpose of the study was to determine the effects of multiple and linear visual presentation and cognitive style on performance in a visual location task. The study also considered whether the scores in a visual location task were affected by the interaction of presentation mode (multiple and linear image presentation) and of cognitive style (Field Dependent and Field Independent).

Most of the research on field-dependence-independence has been conducted by Witkin and his associates and is summarized in a 1977 issue of the Review of Educational Research (Witkin, et al., 1977). Field independents (FI) can give structure to unstructured material and can separate an item from its overall context. Field dependents (FD) on the other hand tend to respond holistically to stimuli. Compared to FI's, FD's have a greater need for and are more dependent on external sources of structure and organization.

When recalling information, the thought strategies of FD's and FI's vary greatly. Field dependents are not likely to depart from the dominant arrangement of the total visual as given, and tend to remember the most noticeable cues, whether or not they are relevant. Information recall in FD's is facilitated if major visual cues are made relevant and is hindered if important cues are irrelevant or if relevant visual cues are not salient. Field Independents tend to be able to identify the most important visual cues whether or not they are the most important (Wilkin, et al., 1977).

In recent years the field of instructional media has begun to develop an empirical base which combines certain unique medium (visual)characteristics and psychological requirements of specific learning tasks (Allen 1974). The existing empirical base is lacking with respect to multiple presentations, perceptual types, i.e., cognitive style, and visual location tasks.

The typical format of visual image presentations has consistently been linear. Since it appears Field Dependent individuals may have difficulty in mental retention of a visual from image to image, the linear format of visual presentations may be inappropriate. Hence, it may be that the format of large amounts of the existing visual material would not be effective for FD individuals. If the use of multiple image presentation enhances the ability for the FD individual to learn visual tasks, then the design of instructional media may be made beneficial for FD's. Since the FI individual seem to have the ability to retain visual images mentally, multiple image presentation may not result in significantly different performance than linear imagery in a visual location task. However, it would seem reasonable to expect that multiple image presentation would reduce the visual task factor, for FI's as well as for FD's. If data can be produced which supports the idea that for certain learning tasks and certain cognitive types, a specific format is effective, then instructional developers would be able to utilize the results in alternate media design (Whitley and Moore, 1979).

Method

Subjects

The subjects of this study were 150 undergraduate college students enrolled in professional education courses. One hundred thirty two (132) students (40 male, 92 female) completed accurately all phases of the experiment. These subjects were identified as field dependents, field independents and neutral by means of the Group Embedded Figures Test (GEFT), (Wilkin et al, 1971). Since the test manual set no guidelines for grouping, subjects were grouped into the above categories in approximate thirds according to their scores, i.e., scores of 15 and above were classified as FI (N=47), 11 to 14 as neutral (N=45) and those with scores of 10 and below as field dependents (N=40). The GEFT has a range of scores from 0-18. A median split was rejected because of the closeness of low FI and high FD scores.

Materials

The experiment used a visual location task and was designed to test the subjects ability to select a criterion picture from a group of three similar pictures after viewing three quadrants (in random order) of the criterion picture. These pictures (15) represented a variety of pictorial styles and were selected from instrument designed by Whitley (1978). Two treatments were developed. All pictures and quadrants were made into Black and White 2 X 2 slides, to eliminate the additional factor of color. They were then videotaped via a film chain in a television studio. Treatment one (linear) presented each quadrant of the criterion picture separately for two (2) seconds, one after another. The criterion picture was then presented with the two similar pictures for a total of six (6) seconds. In treatment two (multiple) each of the quadrants were presented simultaneously on the screen for a period of six (6) seconds. As in the first treatment, the criterion pictures were then presented with the other two similar similar pictures for six (6) seconds, The criterion score was the total number of correct choices (0-15). The pictures used, chosen by a panel, the criteria of similar content, detail and format. Both treatment groups saw the exact same stimuli materials.

task. The independent variables were presentation mode and cognitive style.

Results

A summary table of the factorial analysis of variance based upon the table of means (see Table 1) is presented in Table 2. As can be seen, the college students depending upon their classification as FI, neutral or FD performed significantly different F(2,131)=7.91, p=.0006 on the visual location task. A secondary analysis using the Duncan's Multiple Range Test indicated that FI's ($\bar{X}$=10.553) and Neutrals ($\bar{X}$=9.533) both scored significantly higher than FD's ($\bar{X}$=8.200). Table 2 also indicates that presentation mode (linear vs. multiple presentation) was not significantly different F(1,131)=0.79, p=0.3747 in this study. In addition, there was no significant interaction between presentation mode and cognitive style F(2,131)=.91, p=0.4033. The fact that FI's mean scores was significantly higher than FD's was predicted. However, the results which indicated there were no significant difference in treatment groups was surprising. Added to this fact that FD's actually had higher mean scores on the linear presentation ($\bar{X}$=8.333) than on the multiple presentation ($\bar{X}$=8.053) was unexpected. Both FI's and neutrals had higher mean scores on the multiple treatment than on the linear presentation.

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INSERT TABLE 1 and TABLE 2 ABOUT HERE.

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Discussion

Because of the characteristics of FI and FD subjects described earlier by Witkin, it was expected that FI's would score significantly higher than FD's on a visual location task. The results of this study confirmed this. This fact should strengthen the premise that there are people who have the characteristics of FD and FI as described by Wilkin and that the GEFT does indeed identify these individuals with those characteristics. As noted earlier, it was hypothesized that a multiple presentation of three quadrants would be beneficial to FD types in selecting the criterion picture, because all visual information would be on the screen at one time and not separated. Howell (1972) in an comparison of Lowenfeld's Haptic-Visual theory and Witkin's Field Dependent-Independent theory, suggested that Visual types and Haptic types (from Lowenfeld) tend to match respectively Field Independent and Field Dependent types (from Witkin). Whitley and Moore (1979) reported that the Haptics scored significantly higher with a multiple presentation of a visual location task than with a linear presentation. However, these findings were totally reversed and in this present study and the mean scores of FD individuals were actually higher for the linear presentation than the multiple presentation. Whitley and Moore (1979) inferred that multiple image presentation might tend to facilitate the retention and comprehension of visual cues for Haptic individuals, thus the inferred FD types. The results of the present study may bring into question the close relationship between Haptics and Field Dependents as suggested by Howell (1972) and thus questions Whitley and Moore's inferences as presented earlier in this paper.

Previous research comparing multiple and linear presentations have also tended to produce conflicting results (Whitley and Moore 1979) as does this study. It appears that there may be other factors which may be interacting with presentation mode and cognitive style which might account for the unexpected results. These factors might include intelligence, sex or experience in viewing visuals as well as others. These factors should be studied in the future. Until further results are presented media developers cannot be sure that multiple visual presentations will be of assistance to field dependent individuals as suggested earler in this paper.

The author expresses gratitude to Ms. Janice McBee for help in the statistical analysis.

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Table 1

Correct answer Means by Cognitive Style and Treatment

	N	Mean	Overall Dependency
Field Independent	47		10.553
Linear	19	9.789	
Multiple	28	11.071	
Neutral	45		9.533
Linear	23	9.435	
Multiple	22	9.636	
Field Dependent	40		8.200
Linear	21	8.333	
Multiple	19	8.053	
Overall Treatment			
Linear	63	9.175	
Multiple	69	9.783	

Table 2

3 x 2 Factorial Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F value
Model	5	139.62026	27.92405	3.69
Dependency	2	119.77540		7.91*
Treatment	1	6.00410		0.79
Dependency X Treatment	2	13.84076		0.91
Error	126	953.37215		
Corrected Total	131	1092.99242		

* p > .001

NEW TRENDS FOR NEW NEEDS IN INSTRUCTIONAL TECHNOLOGY THEORY AND DEVELOPMENT

Paper Presented at the
AECT Annual Convention
Anaheim 1985

Anaheim, California
January 1985

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PLAN

INTRODUCTION

I The participation variable

II Lessons from the field: toward reconciliation

- 2.1 Investigations in differing research fields at the university level
  - 1. The PRIM
  - 2. The Ford Teaching Project
- 2.2 Investigation in a collective writing experience with popular educators
  - 1. The writing techniques
  - 2. Lessons

III A few applications of action research

- 3.1 As a technology for collecting data and writing a script
- 3.2 As a technology for writing a regional research proposal
- 3.3 As an evaluation model

CONCLUSION

INTRODUCTION

In the process of writing my report on action research at the end of a four-year grant, I have decided that my contribution to my AECT colleagues will be to share some insights that I have gained as a result of a broad range of experiences. I also wish to describe certain methods that have proved useful in the application of technologies demanding a great deal of participation from persons involved in a research. I offer these observations in the spirit of sharing and discussing. Thus I ask you not to consider presumptious my announcement of new trends; they are proposed in the light of current ideas emanating from the scientific community and scholars, among them Longsheet (1982), Sussman and Evered (1978).

First I will describe the manner and extent to which the participation variable affected my process of evaluating an open model of pedagogy. I shall then indicate some lessons I have learned while investigating various action research groups at university level. For this purpose I have chosen a case history from a research of my own and two from current action research literature. The core of my exposé will be the principles about participation and action research which I distilled from conducting a collective writing colloquium with popular educators. (For term, see note (1). Further, I will show how a participatory approach in action research can serve as a strategy for writing a script, research proposal, course outline or project evaluation.

Finally I will discuss the need to use action research to bridge the gap between practice and theory.

I The Participation Variable

Let me state here that I consider action research a worthwhile research paradigm in the field of instructional technology. In areas such as needs assessment, curriculum development and innovation, action research is as valid and productive as the more favored systems approach, which has been considered the rational, organized and experimental mode of evaluation and revision. In the latter approach, targeted populations were relegated to the role of prospective customers rather than that of participants. My experiences have led me to support action research.

In 1973 I was faced with the dilemma of evaluating an open model of teaching without adequate instruments. Required to evaluate yet equally obliged to avoid disturbing or manipulating any variable, I turned with some of my colleagues to ethnographic tools to examine the pedagogical field and ultimately determine its significance. At the end of the research period I made a summary report, or analysis (Morin, 1979, 1980). To my astonishment, I discovered that we had omitted from our assessment process some important evaluation components. Why? We had wanted to change the environment but we had failed to involve the students as participants in the change process. Eventually we constructed a model that we called anthropopedagogical: anthropo because we were employing ethnographic tools, mainly participant observation, and pedagogical because an educator is active in the field, intervening and working as a change agent. This implies, moreover, that the teacher facilitates student involvement in both their learning environment and evaluation. If decisions are to be meaningful, they should aim to change, as often as necessary, the objects and resources in an educational setting to render it more supportive and productive. Hence students must participate in the totality of their learning experience .

I narrated and publicized my research findings in a poster session in 1979 at the AECT convention in New Orleans. I then decided to explore alternative research methods. My formative evaluation model suggested two possible directions, forcing me to deepen the epistomelogical roots of my position. One orientation was to function as an ethnographer in education; and the second was to focus on action research itself, that is, analysis of an action research model.

Actually I was identifying the theoretical foundations of my action research model so it might serve as more than a purely operational mode to solve immediate problems. I aimed at producing practical knowledge, or savoir-faire, which ultimately would permit an educator to perform routine tasks more easily and solve issues that consume much energy, making the work of teaching and learning more laborious than it needs to be.

On the one hand I wanted to broaden my application of ethnography in education to a broader cultural dimension; I strove to understand the link between macroscopic and microscopic views of phenomena and events. This dimension has been explored in some of the research studies I have directed, but at the present time it has not yet been associated with action research.

I was tempted also to examine the various ways action research is conducted in different parts of the world. In my search for models of action research and data analysis, I was curious to ascertain to what extent action research findings could find credibility in the scientific world. I knew that criteria for an action research paradigm would enable us to judge whether a research study remained faithful to its original methodology and whether a gain in knowledge may be expected.

Thus for four years I have lived a sort of professional schizophrenia. Half of me has aligned itself with colleagues in my field, asking me to be faithful to the definition of instructional technology expounded in my Los Angeles graduate courses (Tickton, 1971).

> (Instructional technology) is a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and non-human resources to bring about more effective instruction. (P. 21)

The other part of me affirmed my trust in a field approach characterized by the participant-observer tradition, drawn notably from practical anthropology (Bastide, 1971). This part of me looked for ways to intervene in the field more as participant than observer, yet always preoccupied with the acquisition and production of knowledge.

Although this divided aspect of my research life is apparent in my paper, I have discovered, I think, some avenues for enriching the traditional font of instructional technology; thus I am either cured or at least en route to reconcialiation. I have achieved a deeper understanding of the educational and instructional research mode. I have become better equipped, possessing both more tools and a more refined concept of action research, one which transcends pure applied research. I can suggest new ideas to enrich the systems approach and an alternate experimental paradigm.

Let me acknowledge that my comprehension of a pedagogical action has been enriched by the analytical tools furnished by certain ideas basic to anthropology. These tools have added clarity and depth to my perception.

Now my reflections may seem to state generalities but I relate them because they bring me to the conviction that one variable is omitted from too many research paradigms,namely participation. This component, which is essential in action research, is also vital in certain developmental models of instructional design. We must remember that a research study always emerges from a context, although experimentalists seem most at ease in a context-free laboratory; they are normally not preoccupied that their research findings be reintegrated with their appropriate contexts. In all types of research a certain degree of contextual participation exists but in action research context is essential.

I wish to emphasize my beliefs about context and participation,reconciling these with deductive reasoning, rationality and the systems approach.

II Lessons from the Field: Toward Reconciliation

In recent years my research experiences have been numerous and varied, both frustrating and encouraging, but always enlightening in some way or another. In this part I will discuss briefly some studies in differing action research fields at university level and the study of a collective writing experience with popular educators. I will then indicate the lessons about action research gained from these investigations, noting especially the participation variable.

2.1 Investigations in Differing Research Fields at the University Level

I have investigated several research projects that claimed a basis in either ethnomethodology or action research. Since my observations will be treated at length in another paper I will merely indicate the material pertaining to participation as seen in two case studies.

1. The PRIM

The PRIM case was a study at Université du Québec à Montréal (UQAM) called "Projet de recherche et d'intervention à la maison",or "Research Project on Intervention in the Home".

The research group dealt with a first cycle program for training special education teachers and social workers to help parents of children younger than five years to acquire the skills and evaluation expertise needed to cope with, accept and educate these children. Trainees were assigned two families each. The trainees were students who, after a few weeks of briefing, worked for several weeks with assigned families and returned to the university to share ideas and experiences. PRIM researchers tried to analyse results and weigh the program's value. They claimed that action research was their principal approach; for this reason, I decided, after reading their project, to study their model.

When we began to listen to them, we discovered that they were using an experimental paradigm and were trying to verify four hypotheses. They were also in the process of constructing measuring instruments and trying to find control groups. Their data later seemed to show no significant difference between control groups and those receiving attention. It was obvious to me,however, in the light of high parental satisfaction and trainees' enthusiasm, that a more adequate measuring instrument was lacking, one which would discern information other than behaviors.

The PRIM researchers assumed their conclusions were right because their instruments had been validated and also considered reliable. How then could they justify the expenditure of continued energy to sustain this superb practice-to-theory project? Their teaching model was action research inspired, intended to encourage interaction between society and the university to serve social needs.

We noted that even though experimental measures could detect some results, the experimental paradigm could not discern and demonstrate the changes in parental attitudes, their participation in the training and evaluation of the children, and the university students' high degree of satisfaction.

Hence we recommended more qualitative, ethnographic measures, and methods based on action research. Trainees must be encouraged to submit many examples and descriptions of their activities. We proposed that increased student participation was a major step toward improving the research model, at the same time providing more data for analysis. Ethnographic and action research methods which demand participation could offer important clues to the resolution of their research dilemma.

We delayed offering our advice, however, because a problem developed which taught us a salient lesson. The observer we sent to the PRIM became increasingly and capably involved in the management of the group, almost taking over leadership at one point. Aggressivity arose, leaving the group unsure about its identity. From that error we learned that whenever a group asks for expertise in participation or action research, negotiation is essential. The whole research group, not merely its leader, must work on what I call an open contract.

A second lesson concerns the fact that action research, although unappreciated in the scientific world, finds sympathetic acceptance from many administrators and, increasingly, with social agencies willing to grant funds.

Finally, I think it is high time we stated action research criteria so researchers will not label their methodology action research merely because they involve themselves with their subjects or carry out activities that normally do not fall under the heading of research.

2. The Ford Teaching Project

The Ford Teaching Project which originated at the University of East Anglia in England, was a genuine action research from the beginning (Adams, Elizabeth, 1980; Elliott, John, 1980). Its underlying assumption was that teachers will change their behaviors only to the extent that they are both aware and critical of the theories behind their practices. Moreover, the teachers must be implied in the construction of theories.

From elementary and secondary schools, Ford researchers recruited forty teachers who taught differing subject matters. It was accepted that increased self-knowledge would enrich the teachers' exploratory and investigative methods of teaching.

Coordination was done by a team of these researchers whose mandate was to develop methods and instruments useful in the collection of data; this central office took over the chore of making generalizations.

At the beginning only one teacher evaluated himself/herself significantly. In the end, twenty-five participants made significant changes in judging their approaches to discovery teaching methods and assessing their own personalities. Eight had dropped out of the project. The teachers' involvement led to the development of many hypotheses, some already verified and others still in the testing stage.

To me, a salient point is that the Ford paradigm demanded full participation by its subjects. Participation,then, induced changes in the teachers because they became increasingly conscious of their self-knowledge. Nevertheless, the practical theories the researchers actually observed through behaviors and attitudes are not considered scientific truths because there are more hypotheses than totally controlled variables. The research model inspired by Lewin is a spiral wherein each pace can be observed, applied, evaluated and corrected before the next step is made: an "action circle" which in turn generates the same pattern of observation, application, assessment and correction.

The Ford research may be called a spiral embedded in the complexities of classrooms at the elementary and secondary levels of many schools. Both effects and process are observed: in a way, the problems are observed while solutions are applied in the teaching practice. These problems may seem minor to the anthropologist or program developer. Nevertheless, just as each cell in the human organism must receive nourishment from, and communicate through, membranes with other cells to avoid the growth of tumors, in the same manner each teaching problem deserves attention and solution when a need develops.

Promoters of the Ford action research model stipulate two conditions, or criteria, for proper functioning: first, the situation must relate to a teacher's field of action; and, second, the teacher must be in a position to effect changes in his or her situation.

In an action research, participation demands conditions that are linked to the action itself: if the field of action is too big it discourages involvement; if it is outside the participant's field of competence, it destroys motivation and interest.

Another important consideration in this model is that clarification of the problem is an ongoing process during the analysis phase as well as in the exploratory phase.

The second step in the Ford research, following identification, is that of "reconnaissance", which presupposes a good description of the situation to further clarify the problem. After problems are classified, this step begins to offer perspectives which were not originally foreseen. From that evolves a search for explanations and the genesis of hypothesis development.

Subsequently, working hypotheses shed light on other information. As long as hypotheses guide action, the analytic process can be maintained.

The third step is to establish a plan of action, such as determining how much one has to negotiate to implement the plan, and what resources are needed. At this stage a rational approach aimed at systematizing the action seems advisable.

Research which implies participation poses the problem of deontology. To what extent can information be diffused? The answer must be elicited from those directly involved in the project.

The Ford research model implies the use of ethnographic tools such as participant observation. In order to achieve optimum objectivity, promoters insist on the necessity of triangulation of data. Their intention is not only to corroborate points of view but also to find correspondences. Thus one can compare data from a teacher, his or her students, and an external observer.

This model, inspired by Rappaport's definition of action research, is interesting because it does not remove us too far from the search for objectivity. Yet it is adventurous, involving a search for signification, for meanings,and it permits a great sense of induction.

One may judge, however, that the knowledge generated,rich as it is, still lacks generalization. Does this really matter if it generates lessons, hypotheses for improvement and enrichment of the context of teaching models and necessary insight into teachers' personalities and lifestyles? Such learning is insightful, useful and practical.

As I see it, however, the teachers were expected to be active participants in the Ford project, but not to the extent that we shall see in my analysis of the next case, in which the participant actors became authors.

2.2 Investigation in a Collective Writing Experience with Popular Educators

Involving subjects in all phases of an educational research is probably an unattainable ideal. My investigation of case studies — of which I report only two here — draws attention to the fact that action research carries various definitions and serves as a vehicle for many purposes and types of studies.

My disappointment in university studies which I believed too imitative of traditional scientific models led me in 1982 to do a study that involved popular education(1) groups. I searched for authentic action and innovative pedagogic strategies (Morin, 1984).

My team accepted as an operational definition of action research the premise that the authors, namely, the researchers, and the actors, or practictioners, must be reciprocally involved. The authors participate in the action and the actors function to some extent as authors. Thus an action research focused on the practitioners themselves, their actions and their transactions. Its aim is to rationalize spontaneous practice.(Desorches,1982)

If its aim is to rationalize, are we not skirting with the systems approach of developmental research, which tries to integrate and systematize human and material resources in order to promote and facilitate learning? No, we are not. While the aim is the same, the means differ. In action research auto-diagnosis is an essential antecedent to auto-prognosis. In action research, the process operates on as well as by means of the actors: they form the study group; their benefit is the research object; and only with their fullest participation can their goals be attained.

Acceptance of the need for participation may not have been recognized by university researchers because the university is a hierarchical micro-society of a wider hierarchical, though democratic, society. Further, assuming that the process of learning belongs to the learner, it is hard to believe that a student does not ultimately retain more when he or she has helped conceive, organize and assimilate material than when it all comes prepackaged. Is not evaluation also more meaningful and acceptable to the student when he or she has played a determining role?

Acting on these assumptions, we decided to become better informed about persons and self-help groups who banded together to teach themselves or solve specific problems without institutional formalities, and often without support from funding bodies. For more than a decade, popular education groups have thrived in Québec and Canada and are now organized in a national association. Some groups have a fragile existence, while others enjoy a sturdy lifespan. I had noted in their inter-group meetings they had manifested the need to record their histories and experiences. Hence my research team decided to organize a colloquium for them in which they would collectively answer that expressed desire. Recruitment of popular education practitioners would be drawn from more than six hundred groups in Québec and at least two hundred in the other nine provinces. They would become writers about their own experiences on topics that they themselves would choose.

Six months before the event we sent a preparatory questionnaire asking each prospective participant to describe his or her groups' objectives and principal activities. We requested some background information about either the person or his/her group. Writing this résumé was already a first step in writing; it also allowed people to know each other a month before the colloquium, since each participant received the résumé of workshop colleagues. Over two hundred fifty inscriptions permitted us to form fifteen collective writing workshops organized around twelve themes.

1. The Writing Techniques

We then prepared for our animators four collective writing techniques to use with the groups; each workshop was free to decide whether or not to use them. These techniques were designed to facilitate verbal exchange and writing. In addition, each workshop was assigned a resource person based on theme, as well as a participant observer who could serve as secretary.

These techniques qualify, I believe, as elements of new methodology for new trends in action research. The first technique is called the "echo-writing strategy". Its aim is to write an editorial on a given theme. The group stays together for the first hour and a half. Two persons, who agree to play the role of editorialists, take notes during the meeting. Over lunch they write a first draft or jot down analytical reflections about what has been said. Ideally the resource person meets with them too. They then read their draft or analysis to their group, which reacts, corrects, evaluates and eventually suggests the content of a second draft. One of the group's members may edit the final text. The group then continues to a second theme and a third one if time permits,using the same process.

The second technique is named the "cycle writing strategy". After a group has become acquainted it selects four questions to be answered during their two days together. Divided into four subgroups they explore these questions for thirty minutes, briefly discussing content matter and suggested titles for each question. Then each four-member subgroup assumes responsibility for one question. Two from each group stay with that question for the next two days while the other two discuss for the first hour and a half, then visit each of the other three subgroups for ninety minutes to provide feedback. The original two, meanwhile, receive members of the other subgroups in succession. All the itinerants return to their original group for the last hour and a half. They now can perceive the transformation of their initial responses and also convey ideas that have been discussed in the other three groups. A final general meeting permits them to draw up some propositions and to refine their final texts.

Although this technique seems complicated, it was used successfully by three groups at our colloquium, adapted to suit their specific needs.

The third technique, called "nucleo writing", is a traditional one, except that in a phase called feedback, two persons meet another subgroup and are replaced by two from another one.

As far as popular educators are concerned, I am sure that these techniques work; they can enable groups to express their rich experiences in a manner that can prove profitable to each other or as lessons for similar groups.

Since the techniques were prepared by instructional technologists, however, they proved a bit intimidating to some persons. Had the popular educators participated in their design, I am sure they would have been both more appropriate and smooth to apply.

2. Lessons Drawn from this Experience

As instructional technologists, we learned from this collective writing research project.(2) Although the colloquium took two years from preparation to the publication of its acts, it offered some disappointments, quite frankly, to my team GESOE (French acronym for Group Studying Open Systems in Education). On the plus side, we gained valuable insights which may be considered guidelines for eliciting greater participation in an action research.

First Lesson: Action research demands negotiation that leads to commitment.

The first condition concerns negotiation. As university professors, or researchers, it appears preferable to be invited by the subjects to participate in an action research rather than to be initiators. A professional who has mastery over a body of pertinent scientific knowledge may conduct a satisfying and satisfactory study. But in action research, intervention by a university professor may provoke or perpetuate conflict, at least in my own province, Québec. I refer especially to groups who oppose institutions and their representatives, however sympathetic they may be. In collective writing, researchers must motivate persons to disclose their personal experiences and write about their activities; they must take enough time for sensitization. When a researcher is recognized as a competent facilitator who will favor dialogue leading up to the final writing, he/she will be invited. In our case, we should have spent two years in long term preparation and another year of immediate work. Thus we could have achieved the goal of every action research: an open, flexible contract based on mutual reflection, congruent with the life and dynamics of the groups cooperating in the research.

It is essential that negotiation occur before, during and after an action research (Pirson, Arteel, etc. 1980). In an experience such as ours, for example, the support of the base or representative persons of target groups is vital.

These representatives should hold key jobs at the organizational level and be treated as equals, becoming as it were, in business parlance, "shareholders". Negotiation in action research leads to a special kind of contract, one which is enunciated in the next condition or principle.

Second Lesson: Action research requires an open contract.

When launching this venture we intended to put on the program only the themes or content matter suggested by members from popular education groups who answered our questionnaire. At that point our contract was open. Although we retained the questions as proposed, participants were still free to change and reorient them. However we should have intervened by trying to understand better the meanings of these suggested themes through informal meetings with some representatives; thus we could have improved the problematic aspects of each theme.

To open up a problematic issue means that one must also give the concerned party a chance to resolve it. We had invited persons to do collective writing, assuming that they understood what would be expected because we had written to them four, five or even six times about collective writing. We believed that the technical work of organizing the group experience fell into our range of expertise. What we failed to account for was the significance of collective writing to popular educators. Inadvertantly we had closed our contract before the colloquium without knowing it. This is the price a researcher can pay by not working every day in the field.

People may want to innovate but they change slowly. During the colloquium participants began to reflect on the event itself. Most of them accomplished the responsibility they had agreed upon but a third of the workshops refused to produce a written, or some form of permanent, document. (They had been provided the means of producing a statement in any medium of their choice.) The lesson is clear: besides giving participants a voice in shaping the problems they will address, a second way to favor communication is to make sure that intentions and general objectives are adequately understood, accepted by all participants, and amenable to modification when necessary. Otherwise one may encounter challenge in various forms, such as argumentiveness, resistance or refusal to participate, or suspicions of manipulation. Avoiding such "adversity" is necessary to good action research, but mastery of the right strategies usually comes with experience. We recognized belatedly that not only should content be chosen in an endeavor like our colloquium, but the process leading to consensus, as well as a generous measure of initiative, must be accorded to participants.

Third Lesson: Action research must be a mutual quest for significations.

We intended the colloquium to fit into the context of a research. To be more precise, we wanted to learn about action research itself and about innovative actions and reflections. We learned more about participation through the organizational experience than from its content.

Our participants ultimately wished to exchange ideas orally, we discovered, since they attached foremost significance to dialogue. We had aimed at making them write their ideas down; it became clear that they did not assign equal value to our intention.

Let us look at alternative research stances. The positivist view of action research is that distance must be maintained between the object and the research subject. In other words, the researcher must keep himself out of the scene as much as possible. I disagree with this viewpoint. In action research the author must go beyond pure phenomenologist knowledge, although he may be part of the dynamics, even if blurring should occur between objective and subjective poles. The action researcher wants praxeology, that is, insight about an action through experience with it. He gains understanding both _from_ practice and _in_ the practice itself.

Thus, the colloquium taught us new ways of implementing participative tools. The four writing techniques which we suggested were channels in which we incorporated the Desroche process (1978) to give people a chance to express their experiences, write about, evaluate and compare them, and finally suggest propositions. Our technical strategies may have seemed strange and scholarly; but our animators' handling of the techniques permitted workshoppers to modify them according to specific needs. Occasionally communication was aggressive, but serious reflection leads me to believe that this release was healthy. Perhaps it was even a sign that despite individual differences and misunderstandings, the final acceptance by a group of an adjusted format did facilitate what we were hoping to achieve.

We are convinced that in future research we must choose our instrumentation with utmost care; above all, we must involve participants in every stage, as we have previously emphasized. I think this is the most satisfactory way of ensuring that we delineate our intentions so that each group will cooperate to optimum mutual advantage.

Fourth Lesson: Action research must transcend the application of theory to practice.

One unmodified idea too often voiced when practitioners or professional persons speak with university researchers is the allegedly superior value of experience over theory. Theory is considered quite useless; in constrast, experience is blindly and confidently accepted. This generalization cries out for nuances.

Western industrial thought since Taylor is embedded with the conception of labor as a process between man and machine expressed in terms of work that is breakable into measurable units of activities. The prestige of science and technology as well as operational and systems theories have given birth to administrative management by objectives for either planning or budgetary policies. Even human relations techniques present themselves as a scientific corpus.

Curiously, the non-rational aspects of management such as change, uncertainty, and the unique character of each situation do seem to concern its professionals. Today one hears talk about "decision in uncertainty" or "decision by intuition" (Schön, 1983). Those who voice these ideas point out the dilemma posed by rigor and relevance. The action researcher confronts opposing camps, expressing differing views of professional knowledge. He has reason to hesitate, since he is caught between acting as a theorician who excels in this domain, or as an artisan working securely within a research framework characterized by change, insecurity and uniqueness.

In such an action research group one learns, contrary to traditional instructional technology, not to be seen as an expert. One must also question the definition of resource person. Participants are true. Agreement between true resource persons researcher and an action group on this matter is essential for effective communication, since theory is not easily applied in social and educational milieux; hence the researcher cannot expert a prestigious and powerful influence based only on his theoretical knowledge. The simple reason is that the researcher has a great deal to learn. His or her ideas will eventually come to light but they comprise only one dimension of knowledge. The other dimension is offered by participants who express their needs and ideas honestly, who open up when they perceive they will be heard respectfully, and their words will not be twisted. Thus they become intermediaries and facilitators within a workshop or action research activity.

Fifth Lesson: In action research one must value the experience of others.

In our collective writing research, we made great efforts to discern the experience of others. For instance, we analysed the written texts produced by each workshop to note complementary material in a participant's background and the text he/she helped to write. We did a sentence by sentence content analysis to perceive discrepancies between experience and expression. Moreover we meticulously studied, with the help of our participant observers, the dynamics of each workshop. Had writers appropriated any suggested techniques? Did their discussions proceed according to Desroche's logical steps; that is, was the content matter titled, organized, evaluated, compared with other data, and some propositions enunciated? Did participants think logically? Was their reasoning deductive or inductive? How did their expression conform to their individual experience?

Another preoccupation arising from our colloquium is the relationship between researcher and practitioners. The latter are not so much customers but cooperators. Yet calling them cooperators and authors in a collective writing research raises questions. If they can challenge the researcher's competence and expertise do they not weaken his authority and autonomy? Moreover the researcher is not the only one searching, nor are group writers the sole authors; hence role definitions are confused. Inherent, unexpressed dilemmas point to a need for reviewing our understanding of the professional knowledge of researchers (Schön , 1983). Certainly any challenge to a researcher must be done with the practitioner's awareness of his or her specialized knowledge and experience. In return, the researcher, having constructed a constellation of meanings, must recognize the capacity of field workers to organize and assign meanings.

The researcher's actions give differing messages to receptors. He/she must take pains to make clear explanations and continue testing the perceptions within real life parameters. Participants in a research must be dialogued with as equals so that mutual understanding of events is achieved. Although a subject may not accept the researcher as an ultimate authority, they must agree to cooperate, withhold judgment, share feelings and understandings, and reveal difficulties in comprehension. Appreciation may coincide with payment for the researcher's services. In return the latter must deliver competencies such as helping the practitioner understand and follow advice, and make his/her own actions logical to the observer's eye. Thus with self-examination and feedback the researcher will use his/her professional knowledge to best advantage in a truly open contract.

Sixth Lesson: Action research must defuse aggressive dialogue and argumentativeness.

Of one thing we are proud: during our colloquium nobody in my research team responded in kind when some participants became aggressive. We listened to grievances, responded mildly, and avoided the games a few people seemed determined to play. We believed in compromise, preferring to maintain a calm and peaceful atmosphere; further, we monitored our own failures to communicate effectively. This enabled us to read the subjects' writing objectively and to evaluate them in the most positive light. We tried to assess to what extent each workshop correctly used suggested writing strategies, and how participants' personal and popular education experiences could be traced in what they wrote. We also respected their wishes by taking six months to get explicit permission from those who wished to have their work published.

Whenever adverse positions affect communication, knowledge and education rarely advance: a negative climate precludes the disclosure and consideration of various viewpoints. There is good reason behind the saying: the harvest is poor in a storm.

With the publication of the acts I recognize that my two-year experience has not only enriched my team but made us better action researchers. Moreover the colloquium obviously has helped at least one subject group: after eight members of a senior citizen group attended the colloquium — each of them working in a different workshop — they were able to use one of the most complex writing strategies to collectively write up their grant request.

Seventh Lesson: Action research demands living with uncertainty and the knowledge that every situation is unique.

Whenever one begins an action research he/she encounters the risks of its dynamics, despite enlightened planning. Moreover one cannot predict ancillary events, in our case such things as last-minute cancellation by a major speaker, an imminent strike that forced us to plan alternate facilities if our university closed, reduced access to support staff, and some participants who were abrasive and stridently vocal. Challenges from circumstances and participants whose goodwill is presumed in an invitational conference for quasi-professionals is unsettling. Thus one must adjust to change on short notice and resolve little problems before they get out of hand.

We attempted all that at our colloquium. The fifteen workshops began well, but only ten achieved our goal for them, producing a collective document. As a researcher I tried to understand the variables. Was resistance due to rain, fatigue, personality conflicts, the after-effects of our wine and cheese, differing expectations, or the level of animators' competence? Or did the ingenuous zeal of a few who were promoting causes, and who read institutional manipulation into the structures, divert and subvert their peers? I believe, after careful analysis, that these persons deliberately deranged us. This was a factor we had not anticipated.

Nevertheless, responsibility for cooperative and relevant exchanges lay with the animators, whose capacities for dealing with difficult participants naturally varied. We were well served by fifteen competent animators, some of them superbly gifted, experienced, and renowned. Most probably the caliber of each animator played a decisive role, given the circumstances.

To sum up, participation is vital if the researcher wants to satisfy clients, engage them fully in their own learning process, and expand a research dimension to its fullest potential. As I noted earlier, the extraordinary PRIM project failed to elicit significant data because, I believe, researchers failed to modify their strategies with the help of the social workers, special education teachers and parents of the learning disabled children.

The Ford Teaching Project, on the other hand, realized rather successfully an action research design that involved observers, coordinators, teachers and their students. It may not have been the ideal action research, eliciting participation at all levels, but it achieved a degree of participation and subsequent research findings that was satisfactory in the light of original agreements and goals.

My collective writing colloquium, conceived as an investigation as well as a supportive mechanism for, and affirmation of, popular educators, turned out to be an action research that taught us a great deal about the process of action research itself, as well as the strategies of collective writing. In asking the actors to become authors we had given primacy to participation.

Thus I have begun to consider participation so important I am asking these questions: Is participation the essence, or heart, of action research? How then can an action research be scientific? Generalizable? Objective? Since these are serious considerations, I propose that we develop an action research paradigm that will gain acceptance and recognition by instructional technologists. Although it may borrow liberally from experimental research and ethnographic approaches, it must have its own characteristics and criteria. This paradigm could serve a complementary function to the developmental or systematic approach used by some of us in research.

III Some Applications of Action Research

3.1 As a technology for collecting data and writing a script.

Action research may be a useful vehicle in the area of research and development. A few years ago I directed a graduate study about writing television scripts aimed at affecting the socio-political attitudes of teenagers. A first script was written with the help of adult experts, and the show received average ratings. Then some teenagers animated by my graduate student wrote a script based on the same ideas stressed in the adult-generated script. They participated simply and wholeheartedly, producing a program similar in plot but significantly different in language, setting, impact and implications; it was also perceived as the more interesting program. My point is this: a participatory device need not cost a great deal. What it does need is time during which the agent can become familiar with a targeted milieu and win the people's acceptance. One further advantage is the positive social value of such an endeavor, which flows from the assumption that it is possible to impact on difficult subjects such as socio-political attitudes in teenagers.

3.2 As a Technology for Writing a Regional Research Proposal

This fall I was invited to work with twenty doctoral students in education from a remote region 500 miles northwest of Montréal. My assignment was to spend one day with them and pick up enough data to formulate for them a research project dealing with structural development in educational research aimed at ameliorating conditions in an underpopulated area crippled by unemployment. During the preparatory week before my trip, the participation concept nagged me. I knew that at the university we could prepare a well-structured proposal for them, trying to incorporate their ideas; but we ran the risk of dampening or extinguishing the students' enthusiasm and determination if they did not identify with the content and projected budget. My task was to meet this challenge in six hours.

I thus considered the students' strengths: each had developed an individual project and, moreover, functioned within a four-member group which in the previous year had written a small group proposal as a serious exercise. Their themes ranged from strategies in education, socio-economic influences on teaching, and the teaching-learning situation to post-secondary and university studies in education. Capitalizing on the background efforts of these four subgroups, I determined to produce a unified, structured synthesis based on their previous analyses and proposals.

En route I devised this strategy: we would play a sort of card game, dividing into two subgroups, with partners coming from each of the four nuclear cells. We would start with a title prepared by the staff of the professor responsible for this off-campus project. Students would discuss the following topics: justification of their title and theme objectives; identification of specific problems; methodology and research plans; and budgetary needs.

For our game we needed only scissors, transparent tape and a supply of white paper. Under the headings of theme, objectives and problem areas, each group affixed on white paper the general statements expressed in earlier proposals. They also added new reflections. After 45 minutes we held a plenary session during which progress and observations were shared. Thus we continued until 5 pm, both exhausted and satisfied. I returned to Montréal with "rushes", or rough copies, of two proposals from which the project director made a montage. Our efforts proved worthwhile, for after the proposal was written, the students sent a letter congratulating the director that their ideas had been respected. Although these participants may not receive their requested allocation, they have expressed their real needs, and they will work to resolve them even if dispensors of grants fail to give them priority status now.

I am happy to report that they have recently begun to raise funds rather than wait for the government assistance that is always tenuous.

You may remark that action research is more like a pedagogy than a research design. My response is that its model **does** ~~not~~ blend into, or merge with, a pedagogy. For this reason action research, although effective, is not an easy strategy to promote and perform.

3.3 As an Evaluation Model

In my research on open pedagogy I carried out what I termed anthropopedagogy (Morin, 1980). As indicated earlier in this paper, student-teacher cooperation in a university course based on an open system was possible at many stages, and students participated in revisions whenever they seemed necessary and productive. This strategy is rather easy but it can readily be neglected or dismissed by professors.

I now believe that an enlarged anthropopedagogical model can encompass the needs assessments of courses, appraisal of cultural elements in one's immediate society, and macroscopic projections on a wider scale. By themselves, however, these efforts are insufficient: such research alone cannot produce the knowledge we need in today's complex world. In our search for significations and models we must borrow tools from anthropology, since we are pedagogues whose duty is to benefit and try to transform the younger members of society. We seek not to impose but enlighten, conscienticize and teach students how to operationalize.

CONCLUSION

I do not wish to imply that conducting action research studies will assist a university professor hopeful of gaining a hard-earned promotion. Quite the contrary. Nevertheless, one who has enough conviction, tenure, tenacity, and concern for enriching education should consider working with the action research paradigm as a means of bridging the gap between educational theory and practice. Perhaps we can talk more often about participatory research, as do researchers from OISE (Ontario Institute for Studies in Education); maybe we should invent more multidisciplinary concepts, such as anthropopedagogy. At least we can work toward establishing the characteristics of action research, as Guba has clarified the naturalistic paradigm.

Hence I expect to publish in the near future a list of criteria concerning action research; they will appear in a French-language scientific review. Some writers, like Lerbet (1982), have tried to reconcile systems and action research approaches, but I believe that, despite these efforts, action research by itself is useful for the following reasons:

1. It forces us to review the relationship between theory and practice;
2. It allows us to uncover systems of thought and action through exploration;
3. It obliges us to review the roles of the researcher ~~and his/her subjects~~; as author and actor;
4. It transforms the instructor, or professor, as well as the student, into a communicator reflecting on real experience (Morin, 1979);
5. It can complement the development of audiovisual material especially geared to its specific audience (Kfoury, 1983); and
6. Above all, it helps us grasp the significance of multiple educational behaviors in a social context, whether in or out of a formal school setting.

What makes action research appealing is that it aims at change through reciprocal transformation of action and knowledge.

The spontaneous action of an individual acquires strength from a group and provokes participatory endeavours in others.

Intuitive knowledge favors enlightened, involved dialogue. Action research, which necessitates a formal or nonformal open contract, implies cooperative participation that ideally leads to group consensus and decisions.

Today's tendency toward conservatism in attitudes as characterized in governmental leadership may signal the need for teachers — especially technologists — to use resources and teaching models that can easily be neglected. We can partially compensate for the diminution of certain freedoms and opportunities by promoting responsibility in students. A major means is to stress participation.

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NOTES

(1) Popular education refers to persons in nonformal educational practice promoting learning which is linked to real life experience and needs. During a 1981 Québec convention popular education was defined as the totality of learning strategies and critical reflections by which citizens act together toward a greater individual and collective conscientiousness regarding their life and working conditions. Their aim, in the short,medium or long term, is social, economic, cultural or political transformation of a milieu. M. Ouellette, Éducation populaire: Loisir et Culturel, et la politique. Loisir et Société, vol. 4, no 1, 1981.

(2) Groupe d'éducation populaire en collaboration avec André Morin. L'écriture collective. Un modèle de recherche-action. Chicoutimi, Gaëtan Morin éditeur, 1984.

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Feedback: Implications for Further Research and Study

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INTRODUCTION

A commonly accepted theory believed to be essential in the learning process is that knowledge of the correctness of response be provided the learner as quickly as possible to enable him to acquire and retain information. This theory of immediate feedback has pervaded instruction since early studies in behavioral science where it found greatest support.

A review of current literature in feedback seems to indicate that more evidence is being generated which essentially questions the validity of the concept of "immediate feedback" as a general procedure and that while its effectiveness in certain types of learning is evident, it is not always an essential part of the learning process. In view of the controversy that appears to exist, this paper will attempt to provide a better understanding of feedback (FB) by assimilating various research data into a philosophy that should have relevance to practitioners involved in the teaching/training/learning process.

FEEDBACK: What is it?

While feedback may literally be defined as "the return to a point of origin of evaluative or corrective information about an action or process" its etiology appears to be so complex that an accurate description of the process and the effect it has on acquisition and retention of information remains obscure. Although there is total agreement that FB plays an important part in the learning process, there is

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still much conjecture regarding what the process involves, the direction it takes, what variables affect it, the learner's role, and the terminal result.

Moreover, FB is thought to be synonymous with reinforcement and, as such, has been categorized as tangible, symbolic and verbal. Van Houten (1980), for example, states that providing visual FB enhances the acquisition of the most complex motor tasks and for FB to be effective, it must be administered precisely and recorded in numerical terms. As described, however, visual FB is a form of reward intended to reinforce an acceptable behavior.

Basically, all FB originates from some source. Although it is believed that the source is technically not a part of FB, the two are often confounded because in order to understand the effects of FB on behavior, the source must be identified and then, its influence upon the response recognized (Ilgen, Fisher & Taylor, 1979). When applied to human learning, FB can prove to be a simple Stimulus-Response (S-R), Yes-No, or a complex remedial situation. If viewed as a unitary variable, its properties may vary in simplicity and complexity along the continuum in which the process itself could take the form of new instruction as FB complexity increases (Kulhavy, 1977). As such, FB may be directional as well as motivational; while it informs learners of what behaviors should be accomplished it can also provide information about the outcome associated with reward, act as an incentive and serve as reward or punishment (Ilgen, et al. 1979).

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In addition, various types and combinations of FB which serve different functions in conceptual and behavioral tasks have also been identified (Brackbill & O'Hara, 1958; & Spence, 1966, 1971),

1. Right-Wrong: FB which follows both correct and incorrect responses,

2. Right-Blank: FB which follows correct responses but does not follow incorrect responses, and

3. Wrong-Blank: FB which follows incorrect responses but does not follow correct responses (Barringer & Gohlson, 1979).

Wrong-Blank and Right-Wrong combinations in verbal FB is said to produce equivalent performance superior to that produced by Right-Blank, however, Wrong, it appears, is a more powerful negative reinforcer than Right is a positive reinforcer (Buss & Buss, 1956). Blank is interpreted as positive FB at the outset of acquisition in the Wrong-Blank situation acquires a positive FB meaning in a few trials. Blank in Right-Blank, however, acquires its appropriate meaning slowly and inconsistently (Spence, 1966). It is conjectured that the superiority of the Wrong-Blank combination over the Right-Blank during acquisition of information may be attributed to the interpretation of Blank as signalling a correct response and/or that Blank acquires its meaning earlier when the Wrong-Blank condition is encountered (Buchwald, 1959). When no FB follows either a right or wrong response, however, a given hypothesis is maintained and the tendency to repeat a response on

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consecutive trials, assuming the Blank to mean "correct", exists (Levine, 1966).

AN ANALYSIS

Despite the many attempts at clarifying FB functions, the total concept of FB remains as controversial now as it was at the time of its inception. The Spencerian view that "the development of a behavioral repertoire in the individual is a mechanical unintelligent analog of the evolution of behavior repertoires in different species" was predominant at the time the field of behavioral sciences was beginning to take a foothold as a science in the 1800's. All behavior was readily interpreted by applying Spencer's theory that complex stimuli, for example, were the result of chaining together of simple reflexes, a theory obviously based on Descartes' reflex arc and Hobbes' argument that all human action could be understood in terms of mechanical principles (Schwartz, 1978).

The impetus to moving inquiry about human nature into the laboratory and to incorporating the doctrines of Associationism into scientific psychology was initiated by Ebbinghaus (1850-1909) who, using himself as a subject, developed a set of empirical laws of association. Implicit was the view that an understanding of complex ideas reflects a past history of association of simple ones. While this was an important step and a first toward behavior theory, it was Pavlov (1849-1936) whose study of conditional reflexes and association of ideas in the laboratory at the turn of the century produced results that could be seen and measured that transformed the study of the laws of the mind into the study of human behavior (Schwartz, 1978).

Influenced by Pavlov's studies, Watson, in America, arrived at behavioristic views, essentially that all there is to human nature is behavior, from an interest in animal research. It was Watson's belief that the same objectives of scientific observation could be applied to the study of human behavior - that the data collected by the psychologist should be no different from those recorded by the physical scientist (Spence, 1956).

While the simple reflex arc theory could adequately describe simple behaviors, it did not suffice to explain complex behavior. It was Thorndike's study of the behvior of a caged cat that resulted in the "law of effect", a theory upon which operant conditoning was later to be based (Saettler, 1968). Behavior, in Thorndike's view was a collection of simple reflexes but one that proposed action with a purpose - not the result of some triggered stimulus, rather the result of some anticipated goal. What primarily influences behavior is feedback - its consequences - which is automatic. Acts that produce favorable consequences are continued and those with unfavorable consequences are terminated (Schwartz, 1978; Spence, 1956).

The impact of this conception of feedback on American education cannot be overly exaggerated. Skinner, establishing his methods on earlier studies by Thorndike and on the results gathered from human and animal studies, was

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convinced that all human behavior is shaped by the reinforcement of correct behavior, clearly an endorsement of the S-R theory.

FURTHER ANALYZED

While there are still those whose propensities are that FB may be encumbered within the S-R theory, research continues to produce evidence that FB is considerably more complex than heretofor thought to be. Annett (1969), for example, analyzes FB as action FB and learning FB. While action FB occurs during a response and may affect the response while it is happening, learning FB occurs after a response delayed long enough not to be affected by the response.

In effect, action FB as it is described may be viewed as a linear S-R condition while learning FB may be identified as a closed loop best compared with Weiner's servo-mechanism model where FB can be graphically represented as a function controlled by the consequences of its own behavior (Annett, 1969). Like a servo-mechanism it has a source; a transducer, a device which measures the input and output of the machine and a FB loop which translates the output measure into a signal which can control the input. Such a FB controlled system has the property of maintaining a set level of outputs regardless of fluctuations in the "load" imposed by the environment. Evidence of these characteristics may be recognized in a simple discrimination act of picking up a lead weight and a

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ball - not as much effort is expended into lifting the light weight as the heavier lead weight. The tendency of the system to maintain equilibrium in the internal environment demonstrates the existence of the servo-control system. An interruption of the system causes a disruption in the equilibrium of the system.

While Annett's (1969) analysis may represent a breakthrough in a better understanding of FB, accumulating evidence indicates that stimuli depend on responses according to the current organization of the entire body in which the nervous system resides, that all behavior involves FB effects (Powers, 1973). Literally, all FB is behavior. When a certain behavior is exhibited, it is the result of FB effects of the individual's output. Presumably behavior is controlled perception, not simply a reaction to some stimulus. Where goals and purposes for behavior could not have been accounted for previously, they can now be viewed as a part of the FB process and, moreover, explain why different variables produce the same results. An animal, trained to walk a certain pattern seems to follow a consistent pattern with each trial, yet upon close examination the movements are not exactly the same. When the cage is tipped, the animal continues to walk the learned pattern, compensating for the tipped cage. The animal changes its behavior though the pattern remains unchanged.

Powers (1973), in explaining this phenomenon, states that all behavior is goal-oriented at all times around the control of certain quantities in respect to specific

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referent conditions. When a learner acts, it is in counteraction to the effects of a disturbance on certain controlled quantities. Only this difference between the quantities and its reference condition produces the response/behavior. It is not the situation that causes the response; it is how the subject or learner perceives the situation.

Controlled perception however does not mean the absence of control by the learner; on the contrary there is control when a new reference condition arises but each action occurs according to a hierarchy of controlled quantities where one controlled quantity is controlled by means of changing the reference level with respect to which a second quantity is controlled - the top of the hierarchy answering the question "Why?" and going down to the second level "How?". Fast enough variations in the controlled quantitites, however, cannot all be sorted out, therefore they become noise with respect to behavior.

IMMEDIATE FEEDBACK

As significant as these various functions of FB have been found to be in the acquisition and retention of information, the immediacy with which FB is presented has long been believed to be essential (Skinner, 1954). Based largely on direct application of Thorndike's Law of Effect and Skinner's operant conditoning assumptions, the practice of presenting immediate FB to reinforce the correct or desired response/behavior immediately and frequently to ensure the establishment of that response/behavior was hypothesized as the result of repeated experiments both in the laboratory and out. To behaviorists, the supportive data amassed was evidence that despite the obvious differences between small animals and humans, all organisms show similar learning process properties. It was generally believed that only by manipulating reinforcement could the behavior of the individual organism be brought under control (Skinner, 1954).

Although pioneering efforts in the application of the reinforcement theory began with Pressey's (Pressey, 1950) punchboard, a device used in giving the learner immediate knowledge of response in self-instruction and self-correction, it was the meteoric popularity of Skinner's teaching machine and programmed instruction efforts in the 60's that seemed to verify the prediction by behaviorists that these techniques would revolutionize education (Skinner, 1960).

Despite the flurry of activity in programmed instruction and the massive amount of data accumulated by behaviorists as to their successes, the use of teaching machines and programmed instruction gradually diminished. Although its demise may be due to teacher resistance in more than a few cases, its disfavor might also be due to the inapplicability of the Skinnerian theory to all learning situations as had been claimed or assumed.

Evidence of the effectiveness of another type of FB, Delayed Feedback (DFB) was concurrently being produced in

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direct contradiction of the theory of immediate FB.

DELAYED INFORMATION FEEDBACK (DIF)

Probably the most important and subsequently the most discussed and examined aspect of verbal feedback has been in the effects of a phenomenon most often referred to as delayed-information feedback (DIF), that is, delaying the presentation of feedback for a period of time. Studies in DIF describe the effect of delay of information on retention to be dependent on the type of information FB, the length of delay and the type of material to be learned. Delay has been shown to improve retention of meaningful, not nonsense, material when the information feedback consists of the entire item with the correct answer (Sturges & Crawford, 1964). Generally, no significant difference has been shown to exist in retention between immediate information FB and DIF when the information FB of meaningful material is only a cue suggesting the correct answer (Brackbill, Bravos & Starr, 1962; Sturges, Sarafino & Donaldson, 1968; Sassenrath and Yonge, 1968).

Although the effects of DIF have been widely researched, assumptions of its etiology reveal as much speculation and disparity among researchers now as ever before. While it can be conjectured that DIF improves later performance as the result of covert, symbolic activity which occurs between the initial presentation and FB (Sturges & Crawford, 1964); it is also theorized that subjects use language to relate delayed FB to earlier learning

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(Sassenrath and Yonge, 1968). The use of response-produced, external or verbal cues to help mediate the delay period or language to related delayed FB to earlier learning are believed to be essential in the regulation of one's behavior with respect to remembering past events and anticipating future events (Brackbill & Kappy, 1962).

On the basis of studies with human subjects, Kulhavy and Anderson (1972) theorize that incorrect responses are forgotten over a period of time and that this forgetting tends to facilitate the learning of correct responses whereas in immediate FB, there is proactive interference from committed incorrect responses. The delay period allows a person to forget the wrong answer which acts as interference and facilitates the acquisition of the correct response. That this Interference-Perseveration occurs is contingent upon the learner and his ability to comprehend the material being tested (Kulhavy, 1977). If the material is too difficult and unfamiliar, and the student attempts answering items by guessing, then the value of FB becomea a moot point.

The theory holds particularly true when test items, for example, are of the multiple-choice type where the stems of the items are identical but the results are antagonistic. Delay-Retention-Effect (DRE) provides the learner with information about the accuracy of what has already been learned and provides an avenue by which wrong answers may be corrected (Kulhavy, 1977; Surber & Anderson, 1975). Positive feedback however, is not affected by the

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interference when given immediately after the response or later, so the delay is less of an issue (Ilgen, et al., 1979).

In comparison with the substantial amount of data supporting immediate FB as an effective instructional technique, scant data on which to develop generalizable assumptions about delayed FB exist. Although there is growing evidence that DRE is more effective under certain circumstances than immediate FB, the wide acceptance of it has overshadowed attempts to reexamine delayed FB in light of new evidence. Additionally, there are studies which show the ineffectiveness or the "no-difference" effect of Delayed-Retention-Effect (DRE) as described in a review of 14 studies by Sassenrath and Yonge (1968) which show only two that favor DIF to be significantly effective in learning efficiency and eleven which show no significant difference. Verbal, concept or discrimination learning is shown not totally affected by DIF, but is affected by the interaction of other variables: size of population sampled (Beck and Lindsey, 1979), composition of population sampled (Krumboltz & Weisman, 1962), lack of control in test administration (Sullivan, Schutz and Baker, 1967), and the amount of cueing supplied (Sturges, 1969, 1972; Sassenrath, 1969, 1975; Spartz & Sassenrath, 1972).

OTHER VARIABLES THAT AFFECT FB

To add to the complexities obviously inherent in the FB process, it is proposed that FB may also be a function of the initial learning state, that individual differences among learners must be considered before any judgement can be made about what may be causing specific behaviors and why (Newman, Williams and Hiller, 1974). Besides the strong relationship found to exist between self-concept and performance (Boersma, Chapman & Battle, 1979) there is indication that students with low aptitude scores received the most benefit from delayed knowledge of results and that students with higher scores show little difference in advantage of one treatment over the other. Joseph and Maguire (1982) propose that individual differences among students must be considered before any judgement can be made about what may be causing a certain behavior and why.

Even as studies attempt to clarify these issues, other interacting variables appear to be actively ivolved in the process. Reinforcement schedules, autonomy need and achievement studied in a programmed course showed that with college students, highest scores were recorded of above-average aptitude students with no reinforcement and the lowest with continuous reinforcement, however on the criterion test, high autonomy-need students scored lower. It could be concluded that students who have high autonomy needs, being high achievers also are frustrated by the expectations and requirements of the instruction and the low autonomy-need group felt more comfortable because they did not feel the need to achieve. Similarly, students with higher academic achievement have been found to have greater ability to give internal feedback (self-feedback) where less dependence on external feedback is exhibited (Lublin, 1965).

Locus of control, another variable related to academic achievement, has been found in some studies to interact with FB. Statistically significant correlation between locus of control and internal FB and external FB variables when academic achievement is used as a dependent variable has been found (Maqsud, 1983; Baron & Ganz, 1972). While the internal aspect of FB has its interacting influences, so does the external. There appears to be a link between FB stimulus and the perceived FB with the stability of that link dependent on the characteristics of the source, the stimulus and the learner - the more positive, the more powerful and credible the source, the more accurately is the FB perceived. Peer influence; teacher power, expertise, status and influence, and status in the environment all affect the FB process (Baron, Cowan, Ganz & McDonald, 1974; Root & Gall, 1981).

Additionally, the effect of socio-economic status, race of learner and experimenter and praise, criticism and silence as FB on performance was studied. While no differences were noted with the type of FB, significant interactions were found (Baron et al., 1974).

IMPLICATIONS

Without doubt, prima facie evidence dictates that application of FB not be attempted indiscriminately nor unpremeditatedly. Yet textbooks freely list "immediate feedback" as one of the essential principles in teaching.

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The texts ignore altogether any other type or combination of FB or the consequences of timing of FB. As a result, teachers have for years striven to return graded test papers as quickly as possible, believing it to be an effective teaching technique.

Of yet greater concern is the current prolific application of the principles which underlie immediate feedback in the design and development of computer-assisted instruction (CAI). Despite the numerous studies that indicate individualized instruction to be a very complex methodology which requires the use of reliable and valid teaching material besides an understanding of individual learning processes, much of the computer software currently available are samples of programmed instruction as it existed ten years ago.

A review of the literature on feedback will also describe other studies of extreme relevancy to those involved in the instructional process. As often as it is suggested, tangible FB, or material reward, may not provide for rapid acquisition of information (Spence, 1971; Spence & Segner, 1967) and sometimes produces the poorest performance (Mims & Gohlson, 1977). There is ample evidence that tangible FB such as candy, toys and money can be effectively used to control human behavior (Anderson, 1967), however there has been a reluctance to employ this method because educators would prefer to use "intrinsic reinforcement". The objection to "extrinsic reinforcement" is the inherent fear that the student will become too dependent on receiving

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such FB and be unable to perform without it. In addition, tangible FB may distract from the relevant stimuli and produce a deficit in performance (Mims & Gohlson, 1977, Spence & Segner, 1967).

Tangible rewards seem to be especially important to disadvantaged, retarded, disturbed, or very young children (Lysakowski & Walberg, 1981). Although tangible rewards are objectionable to many educators, they have been used effectively on a variety of students ranging from high school dropouts to grade school children with academic achievement problems and, in addition, have been successfully employed in a number of settings, from the psychiatric ward to the classroom (Anderson, 1967) to industry (Ilgen, et al., 1979) In certain situations, the extrinsic reward is required in a learning task to maintain control of instructional materials over student responses. It is said that regardless of the quality of the material, unless the student is given an incentive, he will not learn the lesson well. Yet, as described earlier, the effect of extrinsic rewards are highly contingent upon the individual and environmental variables.

Regardless of intent, the accommodation for individual differences in all children would prove to be a difficult, if not impossible task to undertake. Yet, the fact remains that for FB to be most effective, individual differences must be attended to. Forness (1973) proposes an heirarchy of FB and/or reinforcement for different individual types as an initial step in the determination of appropriate

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administration of FB:

1. The competent ones who "learn for the reward of mastery.

2. Those who require positive FB about the correctness of a response.

3. Those who need social approval.

4. Those who react contingent upon the nature of the activity.

5. Those who need token FB (could be symbolic reinforcement).

6. Those who require tangibles such as toys, money, etc.

7. Those who need edible rewards.

Perhaps the most significant application of immediate FB could be found in the development of programmed instruction where immediate responses were required to small frames of instruction. Although the effectiveness and efficiency of the immediate response is still believed to be true, several studies show that performance may be better with no knowledge of response (Lublin, 1965). It is hypothesized that when no knowledge of the correct response is given, each frame demanded more attention from the students and required them to study each frame more carefully. The results of Lublin's study lend support to the idea that programmed instruction should be written in large steps rather than small ones (Krumboltz, 1964). According to Keller (1968) instruction should be in

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principal steps and not simply "frames" in a "set".

CONCLUSION

Clearly, FB is a complex process which can no longer be adequately described within the parameters of the traditionally held S-R paradigm, nor can it be said that "immediate" FB must be given, or that delayed FB is more effective in learning. Rather, FB in all its complexity must be viewed as knowledge of response affected by variables within the individual and in the environment. Although the Skinnerian theory or operant conditioning serves to enhance some types of learning, it has been found to be ineffective in others. A strict adherence to one concept, as is most unfortunately recommended in many textbooks on instructional procedures, ignores the existence of scientific evidence at the expense of the learner.

The developmental study of FB indicates disagreement not on the external manifestations of the theories that have been expounded by Descrates, Thorndike, Watson or Skinner but in their teleology. Each theory appears to have used the latter as a foundation upon which to build a better and more comprehensive theory. There is great similarity between Thorndike's "law of effect" and Power's theory of goal-oriented behavior, for example. The influence of behaviorism and the practice of immediate FB have so pervaded instruction over the past 60 years that much of what have been developed toward the improvement of instruction indicate a total reliance on the guidance of

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immediate feedback. While much data can be provided in proving its success, scant data can be found in support of other methods.

Feedback will remain an enigma until research is conducted comparing the different methods of FB on the same students and the same subject matter. Until then, educators must rely on the sparse current studies on FB to use it effectively and efficiently in instruction.

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A STUDY OF THE RELATIVE EFFECTIVENESS OF VERBAL AND VISUAL AUGMENTATION OF RATE-MODIFIED SPEECH IN THE PRESENTATION OF TECHNICAL MATERIAL

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ABSTRACT

The purpose of this study was to investigate the relative effectiveness of verbal and visual augmentation of rate-modified speech in the presentation of technical material. Research has shown that the complexity of the stimulus material has a direct effect on achievement (or comprehension) at compressed rates. It may be possible to supplement the compressed rates of speed so that results approaching or surpassing normal rates can be achieved. The addition of text or visuals to accompany an aural presentation may provide the additional information necessary to allow the faster compression rates to be as effective as a normal rate. Research also suggests that focus should be directed to the specific learning task being presented. This implies that specific learning tasks, presented via auditory channels, be evaluated using instruments designed to measure achievement of each of those specific tasks. The population consisted of 40 graduate students. Materials used consisted of normal and compressed versions of the Dwyer Heart script, printed copies of the script, black and white simple line drawings and the related evaluation instruments. Subjects were assigned to one of four treatment groups: normal version/no augmentation, compressed version/no augmentation, compressed version/text augmentation, compressed version/visual augmentation. After listening to their respective treatments, students were administered the four achievement tests. Analysis of variance procedures were applied to the data.

Purpose

The purpose of this study was to investigate the relative instructional effectiveness of rate-modified speech used alone and when augmented with either visual or verbal materials in the learning of technical material. Considerable research has investigated the comprehension of verbal materials presented by means of compressed or rate-modified speech (Duker, 1974). A comprehensive review of this research (Olson and Berry, 1982) indicated, however, that limited research has focused on the use of rate-modified speech with technical materials and the effect of verbal and visual augmentation upon comprehension of compressed audio messages. Additional research would provide: (1) information concerning the use of rate-modified speech with material that is technical in nature, (2) a determination of how specific learning tasks are affected by using rate-modified speech, and (3) an explanation of the relative effectiveness of verbal and visual augmentation to rate-modified messages.

Rate-Modified Speech

For many years the rapid learning of large amounts of information has been a continuing educational concern. In more recent years this persistence has intensified. Duker (1974) identified the problem that large amounts of information impose upon the learner. He noted that today's society has become more dependent upon communication, necessitating the listener to accommodate a mass of knowledge that is growing in geometric proportions. The proliferation of journals, newspapers, books and other types of media has evolved to a point where an individual can no longer remain current at the same pace with which new developments occur. The problem that Duker identified 10 years ago is even more apparent today. With the new technologies that the microprocessor affords comes an era where the learner is inundated with material to read or merely peruse at a pace that becomes more rapid every day. The technology that permits society's advancements and developments has also contributed to a knowledge base that has become so enormously unwieldy that the learner cannot keep pace.

This imperative is compounded by the fact that individuals learn at different rates. Since time spent in instruction is an important factor in maximizing instructional efficiency, it is of vital importance to identify a means by which the learner can be aided in increasing the effectiveness of the time spent in learning.

Today's technology has contributed to the current state of affairs concerning the information explosion that plagues the learner. Current technology, however, also offers a number of viable solutions within its own parameters. One means this new technology has provided is that of altering recorded speech so that the instructor or student may adjust the rate of presentation to suit his needs. This technique is termed rate-modified speech or more popularly referred to as "compressed speech" (Silverstone, 1974).

Silverstone described this method of rate modification as the "...reproduction of an original recording in which the word-per-minute ratio is changed to a slower or faster rate of speech without eliminating the pitch or natural quality of the voice."

Considerable research has focused on rate-modified speech and its use in increasing learning efficiency through the auditory mode. These investigations have contributed to an enormous body of knowledge that spans over five decades (Duker, 1974; Olson and Berry, 1982; Orr, 1968). Generally, compressed speech has been shown to be as efficient as normal rates of speech. The average conversational rate at which a person speaks is in the range of 100 to 150 words per minute (Nichols and Stevens, 1957; Silverstone, 1974). A listener can comprehend and process information at a rate up to or approximating 400 words per minute (Silverstone, 1974). This creates a speaking/listening discrepancy since a listener can comprehend spoken material up to four times faster than the speaker can send the message. The result is a listener who becomes bored or whose attention begins to wander.

Substantial research has focused on both intelligibility and comprehension of rate-modified speech. Intelligibility refers to the extent that one is able to repeat information which was presented or to discriminate what one has heard. Comprehension refers to the ability to extract knowledge or information from what one has heard, usually by completing an objective test. Generally, no significant differences have been found between normal and compressed modes in terms of comprehension or intelligibility at rates up to 250 words-per-minute (Foulke, 1966, 1967). Foulke (1971) suggested that this implies a working, auditory processing limit of approximately 275 words-per-minute.

Foulke (1968a) reported that, with word rates ranging from 125 to 400 words per minute, comprehension was found to be adequate until the word rate exceeded 250 words-per-minute. As the word rate rose higher, the level of comprehension decreases in an inverse proportion. Foulke hypothesized that adequate processing time is needed for perception of words in order for comprehension to occur. If processing time is reduced, a decrease in comprehension results. Lost processing time was indicated to be a contributing factor in the level of comprehension. Hausfeld (1981) presented strong evidence for a working memory processing limit of approximately 275 words-per-minute.

Foulke (1968b) indicated that in measuring comprehension, there are two groups of factors which must be taken into consideration: (1) organismic features, and (2) characteristics of the signal. Organismic factors include age, sex, intelligence and previous experience with the subject. Characteristics of the signal are concerned with word rate, method of compression and rate of occurrence of the speech sounds.

Relatively few researchers have devoted adequate attention to the characteristics of the message itself. This third area for consideration includes readability, complexity of information and the relative density of ideas or concepts.

Substantial research has focused on both intelligibility and comprehension of time-compressed speech. Generally no significant differences have been found between normal and compressed modes in terms of comprehension or intelligibility at rates up to 250 words-per-minute (Foulke, 1966, 1967).

Research has been less conclusive, however, in determining the effectiveness of utilizing compressed materials when the content is of a more complex or technical nature. The earlier research in rate-modified speech has generally concluded that faster rates were equal to or more effective than slower rates. Subsequent research, however, raised the issue of using material that was of a more complex, technical nature, and challenged the former conclusion that faster rates were superior.

One methodological problem inherent in much of this research work is that they used a variety of recorded messages which did not take into account the specific learning objectives or tasks and the complexity of information. The efficiency index of Fairbanks used in past studies assumed that all passages used were of equal difficulty and importance.

Factors such as the length of the stimulus materials, density of ideas, items learned and not learned, and the difficulty of items learned and not learned, were not considered (Adelson, 1975). Other research suggests that regardless of the speaking rate utilized, increasing the difficulty of the stimulus material results in a reduction of the amount of material that is comprehended (Spicker, 1963). Grammatical complexity has also been shown to have an inverse effect on the amount of comprehension of compressed material (Reid, 1968). The type of information used has an effect on comprehension and may also represent related but different aspects of listening comprehension.

It has been established that material containing different types of information such as drawing inferences, formulating ideas and dealing with facts yields different results in comprehension of compressed materials (Rossiter, 1971). These finds seem to indicate that material that is more complex or technical in its content would be more adversely affected by higher rates of compression.

There exists from these research efforts substantial evidence that rate-modified speech is a valuable learning tool. The effectiveness of this learning tool, however, may be affected by the addition of certain supplemental information in an effort to provide additional or redundant information via another channel. Since it has been established that rate-modified speech has a positive effect on comprehension of compressed materials, it is conceivable that the addition of text or visual augmentation would further increase this effect.

The use of text and visual materials to augment rate-modified messages has been explored in past research. Generally, their use with materials of varying compression rates has been found to be of significant educational importance. The redundant information provided by the printed text and the additional cues provided by visuals has aided in the processing of the compressed material. It is of interest to determine if these two types of augmentation (text and visuals) provide additional support to compressed material that is of a technical nature. The additional of visual augmentation to accompany an aural presentation may provide the additional information necessary to allow the faster compression rates to be as effective as a normal rate. The use of printed text may provide the redundancy needed to comprehend the spoken material. Similarly, the use of illustrations may provide enough additional information for the learner to organize or restructure the material.

It would appear that the visual augmentation of compressed auditory material may improve comprehension. If such a difference does occur, it is necessary to identify which type of visual augmentation, if any, is more effective in providing for this difference. No research to date has investigated this aspect of comprehension of rate-modified speech.

In consideration of the complexity and difficulty of materials there is also at issue the type of learning task that is involved. Different types of listening learning tasks as those identified by Rossiter (1971) yielded differing results in terms of comprehending rate-modified passages. Further exploration of different learning tasks and objectively measuring their completion may help to determine what specific tasks may be more suited for information that is modified in rate of presentation.

In order to measure the effectiveness of rate-modified speech, it is of major concern to establish a means of standardizing the degree of complexity of stimulus passages and the use of augmentation with the stimulus passages for testing and evaluation purposes. This standardization is imperative for determining results from an experiment and for generalizing to other research efforts relative to this area of investigation.

Orr (1971) identified the problem that exists due to a lack of standardization of testing instruments to measure variables relative to rate-modified speech. Since no one method or procedure for evaluating rate-modified materials is recognized, generalizations from one study to another remain difficult to make and are frequently of questionable validity.

Until the present, no standardized instruments have been developed, and those which had been developed represented a global measure of a variety of learning tasks. Work done by Rhetts (1974) suggests that learning research should also focus on the specific learning task being presented. Such a charge would imply that specific learning tasks, presented via auditory channels, be evaluated using instruments designed to measure achievement of each of those specific tasks. For this reason, a part of the research and evaluation materials developed by Dwyer (1967) was employed in this investigation. The evaluation instruments incorporated into this package allow the researcher to evaluate learner achievement relative to four different learning tasks or objectives: drawing or spatially restructuring information, terminology or recall of specific information, identification or spatial analysis and comprehension* or interrelating information. In addition, a total test measures overall achievement on all tasks. The use of such materials would seem to represent a more precise method of evaluating achievement or comprehension of information via the auditory mode.

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*Note: The term "comprehension" as used in previous research relating to compressed speech should not be confused with the term identifying the Comprehension Test developed by Dwyer. The term as used by Dwyer refers specifically to the ability to "use information to explain some other phenomenon" (Dwyer, 1972), whereas the general term "comprehension" refers to a more generalized ability which could interchangeably be called learning or achievement.

Procedure/Method

The stimulus materials consisted of the 2,000 word instructional script on the parts and functions of the human heart developed by Dwyer (1972). A professional narrator was used to record the normal version of the audio tape at an average rate of 150 words per minute. A compressed version of 250 words per minute was provided by use of the Variable Speech Control (VSC) module.

The supplemental verbal materials consisted of the printed text of the instructional script. The supplemental visual materials consisted of the 39 illustrations identified by Dwyer as the simple line drawing version of the instructional materials on the human heart. These visuals were 35mm slides produced with black lines on a white background. The slides were synchronized to the audio script via a Hollensak 2550 cassette tape recorder at the locations in the instructional script where Dwyer determined that a visual was needed.

The accompanying four achievement tests developed by Dwyer (drawing test, terminology test, identification test and comprehension test) were employed as evaluation instruments.

The population for this study consisted of 40 graduate students at the University of Pittsburgh. Care was taken to exclude any individuals having had prior, formal training in medicine, physiology or anatomy as well as any subjects trained in Cardio-Pulmonary Resuscitation (CPR). Students also excluded from the study were those with a diagnosed hearing loss or visual impairment as well as students who did not speak English as a first language.

Subjects were randomly assigned to one of the four treatment groups: Normal version/no augmentation, Compressed version/no augmentation, Compressed version/text augmentation, Compressed version/visual augmentation. Small groups listened to their respective versions of the script augmented by text or visuals where applicable. Upon completion of the experimental treatments the subjects were immediately administered the four achievement tests.

Findings

One way analyses of variance were calculated to determine if differences existed among the means of the four treatment groups for each of the achievement tests. Where overall F values were found to be significant, Scheffe post hoc comparisons were conducted.

The means and standard deviations for each of the four treatment groups (Normal version/no augmentation, Compressed version/no augmentation, Compressed version/printed text augmentation, and Compressed version/visual augmentation) across the five objective tests (the drawing test, the terminology test, the identification test, the comprehension test, and the total test) are presented in Table 1.

The results of the analyses of variance for each of the achievement tests are presented in Table 2.

An F value of 3.41 was obtained for the drawing test. This value was significant at the .028 level. Pairwise comparisons among means were conducted via the Scheffe test. Results of the test indicated that treatment 4, the compressed version (250 wpm) with the visual augmentation group

TABLE 1

Means and Standard Deviations of the Four Treatment Groups

	Normal/no augmentation N = 10		Compressed/no augmentation N = 10		Compressed/ printed text N = 10		Compressed/ visuals N = 10	
	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.
Drawing test	6.30	3.83	4.90	4.63	6.60	5.04	10.90	4.15
Terminology test	13.00	3.77	8.00	3.43	10.30	3.13	9.20	4.39
Identification test	11.50	5.52	8.20	3.79	9.60	2.72	11.30	4.00
Comprehension test	11.40	2.67	8.60	3.20	11.40	3.24	8.00	2.75
Total test	42.20	12.50	29.70	12.12	38.00	11.40	39.40	12.40

TABLE 2

Results of the Analyses of Variance

Test	F	p
Drawing test	3.41	.028
Terminology test	3.31	.031
Identification test	1.42	.254
Comprehension test	3.68	.020
Total test	1.97	.136

achieved significantly higher than did treatment 2, the compressed version (250 wpm) with no augmentation group. No other significant differences were found.

An F value of 3.31 was obtained for the terminology test. This value was significant at the .031 level. Comparisons among the means via the Scheffe procedure indicated that treatment 1, the normal version (150 wpm) with no augmentation achieved significantly better than treatment 2, the compressed version (250 wpm) with no augmentation.

An F value of 1.42 was obtained for the identification test. This value was not significant (p = .254).

An F value of 3.68 was obtained for the comprehension test. This value was significant at the p = .020 level. However, pairwise comparisons via the Scheffe procedure indicated no significant differences.

An F value of 1.97 was obtained for the total test. This value was not significant (p = .136).

Conclusions and Discussion

A number of conclusions can be drawn from the analyses obtained in this study.

With regard to a spatial restructuring task as measured by the drawing test:

1. Visual augmentation to compressed speech is more effective than compressed messages presented without augmentation. It is clear that a task such as this relies heavily upon spatial information. Such information is provided by the visual material used to augment the compressed recording.

2. The data further suggest that in those cases where no visual augmentation is provided, both compressed and normal messages are equally effective. Such a conclusion would lend support to the use of compressed messages regardless of augmentation in those cases where instructional efficiency in terms of time is desirable.

With regard to the recall of specific information as measured by the terminology test:

1. The evidence suggests that normal presentation rates are superior to compressed rates when information is technical in nature.

2. In those cases where compressed presentation rates are used, augmentation of any type does not appear to be a significant factor.

With regard to spatial analysis tasks as measured by the identification test:

1. The data suggest that compressed messages do not differ from normal messages in terms of their instructional effectiveness. For this reason, rate-modified messages may be considered instructionally more efficient in terms of time with no loss of effectiveness.

With regard to the interrelationship of information as measured by the comprehension test:

1. Evidence indicates that for a task of this nature compressed messages do not appear to differ significantly in their instructional effectiveness from those presented at a normal rate of speed.

It is of importance to note that although a significant F value was obtained, no significant pairwise comparisons could be identified. Such a finding would make the above conclusion tentative and may suggest a need for further research.

With regard to overall understanding of technical information as measured by the total test:

1. The data suggest that no reason exists to believe that compressed messages differ in instructional effectiveness from normal rate messages when the information presented is technical in nature.

2. The data further indicate that compressed and normal speed materials are not equally effective in facilitating student achievement of different instructional objectives. The rate of presentation most effective in presenting information is dependent upon the type of learning task.

3. The effectiveness of a particular type of augmentation to a compressed passage is dependent upon the required instructional task.

The fact that various types of augmentation to compressed materials represent varying degrees of information, redundancy should be further explored.

4. The degree of information redundancy provided by varying types of augmentation techniques does not appear to be related to the overall instructional effectiveness of the message. Although the overall degree of redundancy differed from 100% in the text augmentation version to slight redundancy in the visual (labels of terms on diagrams), the effectiveness

of those techniques appears to be more directly related to the type of information useful in completing the learning task.

The findings of this study strongly suggest that further research be conducted to confirm or disconfirm the hypothesis that verbal and visual augmentation of rate-modified speech is an effective supplement in the learning of technical information. Research should focus on more specifically analyzing the stimulus passages utilized with regard to their complexity, readability, density of ideas and length. Further research should also address the use of augmentation which varies in its degree of visual complexity and redundancy.

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Relationship Between Dogmatism, Self-Esteem, Locus of Control, and Predisposition Toward Two Instructional Methods Among Female Nursing Students

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and Technology

Anaheim, California

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Introduction

The study of personality traits, instructional methodologies and the interaction between the two is not a new area of study. Studies of these interactions, by their nature, pose such general questions as: (1) Do complex learner aptitudes interact (either positively or negatively) with methods of instruction to predispose certain learners to success or failure in a given instructional setting? (2) Should it not be the task of educators to research and analyze these interactions and inform teachers of the possible implications of the use of certain instructional methods in the course of teaching?, and (3) If interactions between learner aptitudes and instructional methods exist, should not research be undertaken to identify instruments which will assist the teacher in identifying learners who may experience difficulty in learning through a certain instructional method? This study attempted to investigate just such questions.

Improving a student's performance in the learning situation may be accomplished by presenting the instruction in a manner which the student most easily comprehends and accepts.[1] The introduction of audio-visual materials and independent instruction into the educational process affords increased diversity in the types and methods of instructional presentations educators make available to their students. Identifying reliable instrucments to assist the educator in choosing an apprpriate instructional approach for each student is a task confronted by this type of research. The task of this study was to discover the relationship between students' scores on three psychological instruments and their performance on tests of cognitive content presented through two differing instructional approaches.

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[1] C. M. Charles, Individualizing Instruction (St. Louis: C. V. Mosby, 1980), pp. 64-72.

Achievement in any learning situation is dependent on a number of variables, such as how well the teacher teaches, how pleasant the learning environment is, and how well the student slept the night before. In addition to the external variable which may be present, each person comes to the learning situation with a unique set of personality traits which may affect, either positively or negatively, his or her chance for success.[2] These traits may include such variables as intelligence, anxiety, motivation and self-esteem. Further confounding the learning situation is the possibility of interactions among these variable, as well as interactions between the variables and the instructional method being used. The recognition that personality traits may affect a student's performance in an instructional setting is an important step toward improving the educational process. Attempts to increase the efficiency and effectiveness of instruction have focused on many variable which are often present in any learning environment. This study investigated three personality traits which a learner will bring to the instructional setting.

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[2] James A. Wakefield, Using Personality To Individualize Instruction (San Diego: California EdITS, Publishers, 1979), p. 17.

In order to maximize the potential of each learner, individual differences must be considered when designing instructional approaches.[3] Educators should direct learners in the same intellectual and development directions, and at the same time they must consider the different methods which may help the learner achieve their learning goals. To deal with the individual, varying methods must be made available to the learner to meet his or her goals. Thus, the task assigned to educators is twofold: (1) develop diverse activities to help the individual learner achieve his or her educational goals, and (2) devise methods of student assessment to assist students in determining which of these diverse educational opportunities will, for them, yield the best results. The identification of potentially successful instructional methods begins with an assessment of the learner. The educator should have the ability and opportunity to administer personality trait assessment instruments which have been shown to be related to achievment in the methods of instruction to be utilized. This study attempted to assess the relationship between student scores on three personality trait instruments and the level of student achievement in two differing instructional settings.

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[3] R. M. Gagne, "Instructional Variables and Learning Outcomes," *The Evaluation of Instruction: Issues and Problems*, eds. M. C. Wittrock and D. Wiley (New York: Holth and Winston, 1970), pp. 105-125; R. S. Dunn and K. J. Dunn, "Learning Styles/Teaching Styles: Should They. . . Can They. . . Be Matched?," *Educational Leadership*, 36, No. 4 (1979), pp 238-244.

The following questions were the basis for this study:

1. Is there a significant difference between the pass/fail performance on tests of content taught through mediated self-instruction and tests of content taught through didactic, large group lecture instruction?

2. Are there significant distinguishing interaction characteristics for those passing or failing a test of content and scores on the Dogmatism Scale, the Internal-External Scale and the Self-Esteem Inventory?

The following are the limitations imposed upon this study:

1. This study was limited to nursing students in a baccalaureate degree program at a private, urban institution.

2. Students were drawn from the third year nursing class only (first year of actual nursing instruction).

3. Only female nursing students were included in the analysis.

Personality Traits and Individual Differences

The concept of individual differences has been explored by researchers for many years. All people do not look alike, talk alike or hold the same beliefs. The knowledge that people differ through a wide variety of traits is the point from which this research has embarked. All types of information about the characteristics of learners has been collected in schools. Such traits as nationality, sex, grade point average and socioeconomic background are routinely ascertained.[4] In addition, various psychological attributes of the learner are often evaluated to determine the intellectual, social and emotional status of the student. These measures are often used to place students in homogeneous groups within the school for instructional purposes. Student grouping of this sort are attempt to mold the student to the instruction, rather than mold the instruction to the student. Cronbach and Snow point out:

> Aptitude measures and educational methods should form a mutually supportive system. Educational programs need to be designed for the student who does not fit the conventional instruction, and classification

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[4] J. W. Brown, K. D. Norberg and F. Harcleroad, A-V Instruction: Technology, Media and Methods (New York: McGraw-Hill, 1977), pp. 17-29.

> procedures need to be designed to choose the right participants for each such program. The old mandate was, "The institution is given; try to pick the persons who fit it." The needed mandate is, "Try to design enough treatments so that everyone will be able to succeed in one of them, and route the person into the treatment that fits."[5]

Media specialists have often been called upon to produce multiple instructional treatments for various instructional settings. Media specialists have for years espoused the importance of assessing the intended audience for which they are designing materials. Any discussion of the role of the developer of instructional programs will include, as a critical component of the instructional development process, the assessment of the intended audience.[6] The purpose of this assessment is to ascertain that the instructional treatment being designed will meet the educational requirements of the group of people for which it is intended. After this assessment is completed, materials are produced, strategies determined, environments are selected and evaluation instruments prepared.[7] The results are often presented as a series of scores distributed along a normal curve. Yet, if this instruction was designed to "fit" this audience, researchers must question why some students do quite well and others do poorly. Perhaps the reason is that each learner brings a particular set of attributes and characteristics to the learning setting which, to a degree may predispose each learner to success or failure in that setting.

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[5] Lee Cronbach and Richard Snow, Aptitudes and Instructional Method (New York: Irvington, 1977).

[6] Brown, Lewis and Harcleroad, op. cit., p. 19.

[7] C. E. Cavert, An Approach to the Design of Mediated Instruction (Washington, D. C.: Association for Educational Communications and Technology, 1974).

Glaser identifies individual differences as a relevent component of the educational process and calls for the assessment of these differences and the utilization of these differences in planning instructional strategies.[8] Cronbach and Snow identify personality traits as important factors when considering the adaptation of the educational process to the individual.[9]

The investigation of interaction between treatments and trait variables has been called Trait-Treatment Interaction (TTI) or Aptitude-Treatment Interaction (ATI) research.[10] In ATI studies the task is to predict appropriate learning methods for subjects possessing certain levels of a given trait, thus allowing them to obtain their highest level of achievement. When various differing instructional programs are available within a course of study, interaction paterns may be used to predict which program will bring about the best results for each student.

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[8] Robert Glaser, "Individuals and Learning: The New Aptitudes," Educational Researcher, 1 (1972), 5-13.

[9] Cronbach and Snow, op. cit., pp. 2-6.

[10] ibid.

Instructional Methods

The verbal instruction most commonly observed in the lecture hall at many schools is an excellent example of what Ausbel[11] and Wittrock[12] have called "expository teaching." In this type of instructional setting, the learner is required to listen, and perhaps take notes, while the instructor poses questions and then answers them. Lecture is a passive mode of learning which allows little chance for asking questions or responding with answers. While the passivity of lecture is a drawback when attempting to involve students in their own learning and adapt instruction to each individual learner, it can still provide useful learning experiences. When properly organized, expository teaching can present facts, concepts and principles which students can learn and use as a basis for further learning and study.[13]

The process of learning is unique to each individual. The educational system makes various experiences available to each student. The schools provide materials, facilities, resources and instructors. The learner also brings certain traits to the learning experience. Gagne stresses the importnace of viewing the educational process as a systematic presentation of instruction to diverse and constantly adapting individuals. The focus of education must be the student.[14] According to Edling,[15] independent instruction is the methodology which seems to be the most flexible and adaptable to the differences between learners. In his discussion of individualization of instruction, Edling identified independent instruction as the method which provides the most freedom to the learner.[16] Independent instruction gives the student the opportunity to make decisions concerning the location and time of the instructional experience, the materials to be used and the rate at which they will be assimilated.[17] One or more of these decisions may be the single most important component in adapting the instruction to the student. Often, more than one of these components is able to be manipulated by the student in independent instruction. The way students manipulate their learning environment is as much a function of their personality as is the way they learn.[18]

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[11] D. p. Ausbel, The Psychology of Meaningful Verbal Learning: An Introduction to School Learning (New York: Grune and Stratton, 1963), p. 19.

[12] M. C. Wittrock, "Verbal Stimuli in Concept Formation: Learning By Discovery," Journal of Educational Psychology, 64 (1963), pp. 183-190.

[13] Ausbel, loc. cit.

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[14] Robert M. Gagne, "Instructional Variables and Learning Outcomes, "The Evaluation of Instruction: Issues and Problems, eds. M.C. Wittrock and D. Wiley (New York: Holt, Rinehart and Winston, 1970), pp. 105-125.

[15] J.V. Edling, Individualized Instruction: A Manual for Administrators (Corvallis, Oregon: Continuing Education Publication, Oregon State University, 1970).

[16] Ibid.

[17] Brown, Lewis Harcleroad, op. cit., pp. 22-29.

[18] Ibid.

The teaming of audiovisual instruction with independent study is a methodology which has gained increasing popularity in higher education in the last ten years. The creation of learning centers, facilities where students learn independently through the use of audiovisual materials, is widespread. Sullivan[19] lists 1,778 individual learning centers in colleges and universities in the United States and Canada. Learning centers are defined as facilities where materials, both print and non-print, are stored and utilized.[20] In addition, these learning centers often become the area in a school where independent instruction is implemented.[21] Anderson[22] described this center as a place where students interact with materials while working in an independent instructional mode. It is in these centers that the technology of education meets independent instruction to form mediated self-instruction. Learning centers allow students to function independently. Students may schedule their time, arrange their work space and freely access technological resources and multiple modes of communication.[23] Thus, if education is to adapt to the needs of the learner, it would seem that mediated self-instruction in special learning centers designed specifically for that methodological approach would be the most appropriate place to study instruction and learner aptitudes.

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[19] L. L. Sullivan, Guide to Learning Centers in Higher Education (Portsmouth, N. H.: Entelek Press, 1979).

[20] J. W. Brown, K. D. Norberg and S. K. Srygley, Administering Educational Media: Instructional Technology and Library Services (New York: McGraw-Hill, 1972), pp. 36-48.

[21] Brown, Norberg and Harcleroad, op. cit., pp. 34-37.

[22] Robert Anderson, "Sustaining Individualized Instruction Through Flexible Administration," The Computer in American Education, eds. D. Bushnell and D. Allen (New York: McGraw-Hill, 1967).

Personality Variables

Dogmatism

Dogmatism is defined by Rokeach[24] as a component of a person's personality which defines the degree to which a person can evaluate, accept, and act on on relevent information independent of extraneous outside factors. A person's level of dogmatism can be classified somewhere along a continuum which ranges from "open" to "closed." An open belief system is one which allows the individual to accept new, novel and often conflicting information and integrate this information into his or her belief system. People with open belief systems are often characterized as broad-minded, liberal, tolerant, receptive and unprejudiced. New information may be integrated rapidly, even if this means that old beliefs must be modified or discarded. A closed system of beliefs is one that defends itself against conflicting information. The person with a closed belief system is often hesitant to accept input which negates or disproves currently held beliefs. Closed belief individuals (high dogmatics) are often characterized as narrow-minded, intolerant, rigid and prejudices.[25]

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[23] Brown, Lewis and Harcleroad, loc. cit.

[24] M. Rokeach, The Open and Closed Mind (New York: Basic Books, 1960).

High dogmatics, then, may be supposed to resist and perhaps reject unfamiliar and possibly threatening new situations. Students who test as highly dogmatic may carry with them a predisposition to failure (or at least diminished performance) when confronted with the mediated self-instruction methodology of education.

Self-esteem

In the study done by Coopersmith[26] self-esteem is defined as a person's evaluation of himself. Self-esteem is the manifestation of the approval or disapproval one feels about his or her own skills, intellectual abilities, aptitudes and morals. It is a "personal judgement of worthiness that is expressed in the attitudes the individual holds toward himself."[27] Coopersmith found a high correlation between self-esteem and creativity. He considered self-esteem a critical factor in determining the degree to which a person can act confidently and successfully on an independent basis.[28] Self-esteem also relates to the ability of a person to organize chaos into order.[29] Coopersmith also found that self-esteem correlated with achievement and sociometric choice.[30]

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[25] Ibid.

[26] Stanley Coopersmith, The Antecedents of Self Esteem San Francisco: W. H Freeman, 1967).

[27] Ibid., p. 5.

Locus of Control

Locus of control can be defined as a measure of the degree to which a person believe she or he controls reinforcement (reward) for his or her own actions. Rotter,[31] in his social learning theory, attempts to explain behavior through "expectancy" and reinforcement "value." The behavior of an individual can be predicted if it can be determined to what extent that behavior will lead to reinforcement and what the value of the reinforcement is. Individuals place different values on the importance of external reinforcement in governing their actions. The ability to assess the importance of reinforecement to the individual is critical in anticipating behavior. Hersch and Scheibe[32] found that individuals evaluated as being "internals" (belief in control of their own reinforcement), describe themselves as being assertive, independent, powerful, effective and industrious. Internal control has been shown to be positively correlated with motivation.[33] Externals (viewing reinforcement as coming from outside their control) are described as more aggressive and hostile,[34] suspicious and mistrustful,[35] and more dogmatic and authoritarian.[36] External control has been shown to correlate positively with debilitating anxiety while internal control correlates with facilitating anxiety.[37]

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[28] Ibid.   [29] Ibid.

[30] Stanley Coopersmith, "A Method of Determining Types of Self Esteem," Journal of Abnormal and Social Psychology, 59 (1959), 90.

[31] J. B. Rotter, Social Learning and Clinical Psychology (New York: Prentice-Hall, 1954).

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[32] P. D. Hersch and K. E. Scheibe, "On the Reliability and Validity of Internal-External Control as a Personality Dimension," _Journal of Consulting Psychology_, 31 (1967), 609-614.

[33] J. B. Rotter and R. Mulry, "Internal versus External Control of Reinforcement and Decision Time," _Journal of Personlaity and Social Psychology_, 4 (1965), 598-604

[34] C. B. Williams and H. L. Vantress, "Relation Between Internal-External Control and Aggression," _Journal of Psychology_, 71 (1969), 59-61.

[35] A. G. Miller and H. L. Minton, "Machiavelianism, Internal-External Control and the Violation of Experimental Instruction," _Psychological Record_, 19, (1969), 369-380.

[36] J. B. Rotter, M. Seeman and S. Liverant, "Internal versus External Control of Reinforcement: A Major Variable in Behavior Therapy," _Decisions, Values and Groups_, ed. N. F. Washburn (London: Pergamon, 1962), 473-516.

[37] E. C. Butterfield, "Locus of Control, Test Anxiety, Reaction to Frustration," _Journal of Personality_, 32 (1964), 298-311.

DESIGN OF THE STUDY

Background

This study meets the traditional definition of an experimental design as defined by Kerlinger.[1] By measuring differences in performance, the study attempted to determine the effect personality traits (dogmatism, locus of control, and self-esteem) have in two varying instructional settings.

This study was designed as a modified Posttest Only Control Group design, as defined by Campbell and Stanley.[2] Rather than compare one experimental group to a control group which has received no treatment, the study compared two groups which have received the same instruction through two different methodologies. The form of the design is illustrated below:

r	X1	01
r	X2	02

with X1 being the lecture method and X2 being the mediated self-instruction treatment. The subjects were randomly assigned to each group to meet the assumption of statistical equivalence of the groups prior to the introduction of the treatment variable.

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[1] Kerlinger, Foundations of Behavioral Research, pp. 327-346.

[2] Donald Campbell and Julian Stanley, Experimental and Quasi-experimental Designs for Research (Chicago: Rand McNally College Publishing Company, 1963), p. 25.

Four instruments were used to collect data: Rotter's Dogmatism Scale (DS), Rokeach's Internal-External Scale (IE), Coopersmith's Self Esteem Inventory (SEI) and multiple choice posttest for content on Tracheostomy Care (Trach) and Intravenous Therapy (I.V.)

Sample

Subjects for this study were drawn from female students in the third year class of the School of Nursing at Loyola University of Chicago (N = 159). The majority of the students in the sample were under 22 years of age (90.6 percent), had a grade point average between 2.50 and 3.40 (73 percent) and had no other post-secondary degrees (88.1 percent) As the nursing curriculum at Loyola is an upper-division major, third-year (junior) students are actually taking their first nursing classes in the first semester of their third year. Because mediated self-instruction was one of the treatments to be investigated, the effects of the treatment on the performance may be more obvious on students relatively unfamiliar with this novel instructional setting.

Group Design

Two treatment groups were designed through cluster sampling.[3] This technique was required because of the instructional groupings imposed upon students by the demands of the nursing curriculum. The

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[3] Kerlinger, op. cit., p. 130.

School of Nursing arranges students into "master groups" which are in turn grouped togehter into clinical agency teams. There are no more than ten students in each master group, and a clinical team is composed of either three or four master groups. There were five clinical teams in the junior class, and teams were assigned randomly to one of the two experimental groups. Also, it should be noted that individual students were assigned to clinical teams on a random basis.

Data Gathering Instruments

There were two areas in which data concerning the subjects were needed: (1) their performance on two tests, and (2) their scores on three personality scales. Two posttests were used to assess students' understanding of the lessons on Tracheostomy and Intravenous Therapy. These instruments had been used in the School of Nursing for two years previous to this research and had been constructed from the objectives of the lessons in question. These instruments had been evaluated for content by a team of eight nursing instructors and had proved to be valid through two years of use. The objective test to assess the students' understanding of the content presented dealing with Tracheostomy care consisted of 27 multiple choice questions. The objective test of the content dealing with Intravenous Therapy consisted of 21 multiple choice items. These tests are criterion referenced: students are normally required to complete these tests as many times as necessary until they pass. A passing grade of 70 percent was established by the school curriculum committee. Thus, students must correctly answer 19 questions to pass the Tracheosomy test and 15 questions to pass the Intravenous Therapy test. Only the students' first efforts on each test were included in the data analysis. In the analysis, student scores were recorded to one (1) for a passing grade and zero (0) for a failing grade. This was done to provide a dichotomous variable for the discriminant analysis of the data. Reliability calculations (Kuder-Richardson) were conducted on both exams. These calculations showed a reliability coefficient of .720 for the Tracheostomy exam and a .673 for the Intravenous Therapy exam.

The personality traits to be studied were assessed through the use of the Dogmatism Scale, the Internal-External Scale and the Self esteem Inventory. These instruments were used in their modified form for adults, as described by Frerichs.[4] The combination of the three scales created an instrument 127 items in length (not counting the five demographic data items which preceded the three personality scales).

The Dogmatism Scale (DS) is a 40-item scale consisting of a series of statements formulated to measure the openness of the individual's belief system. The format of the instruments is an "agree-disagree" forced choice design. All 40 statements are phrased in a dogmatic manner. If the student agrees with all 40 statements, he/she will have achieved the highest possible score and thus will be assessed as highly dogmatic. Rokeach reports a mean test-retest reliability coefficient of .74.[5] Alter and White reported split-half test-retest reliability over five months of .75 and over six months of .73.[6] Other studies using the Dogmatism Scale revealed essentially the same findings.[7]

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[4] Marian Frerichs, "Relationship Between Age, Dogmatism, Internval vs. External Control, Self Esteem and Grade Point Average Among Community College Nursing Students," (Doctoral dissertation, Northern Illinois University, 1971).

The Internal-External Scale (IE) is a 29-item forced choice scale with two statements within each item. Subjects are asked to choose one of the two statements from each item which most accurately states what they believe to be true. One statement is an "internal" locus of control response; the other is an "external" locus of control response. In scoring the instrument, the "external" answers are totalled. Rotter (1966) reports a test-retest reliability coefficient of .78 after a one-month period.[8]

The Self Esteem Inventory (SEI) is a 58-item scale in which subjects are asked to decide whether the statements are "like I usually feel" or "not like me." Eight items included among the 58 comprise a lie scale and are not included in the scoring. The instrument examines the subjects' self-esteem in four areas: peers, family, schools, and personality interests. Scores on the SEI may range from zero (0) to 50. The higher the numerical score, the higher the level of self-esteem indicated by the respondent. The Self Esteem Inventory has produced a test-retest reliability coefficient of .88 after five weeks and .70 reliability after three years.[9]

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[5] Rokeach, The Open and Closed Mind, pp. 89-90.

[6] Richard Alter and R. J. White, "Some Norms for the Dogmatism Scale," Psychological Reports, 19 (1966), pp. 967-969.

[7] J. B. Hough and R. Ober, "The Effects of Training in Interaction Analysis on the Verbal Teaching Behavior of Preservice Teachers," Interaction Analysis: Theory, Research and Application, ed. E. Amidon and J. Hough (Reading, MA: Addison Wesley, 1967).

[8] J. B. Rotter, "Generalized Expectancies of Internal versus External Control," pp. 10-13.

Treatment

The three personality profile instruments were administered to the students by their master instructor. Students were allotted as much time as they needed to complete the three instruments.

The treatment consisted of the viewing of two instructional lessons by each of the two treatment groups. One group ("A"), as a whole, viewed a lecture on care of the patient receiving Intravenous Therapy and they were then assigned to view at some time in the next nine weeks a filmstrip/cassette program on care of the patient with a Tracheostomy. The second group ("B") viewed a lecture on care of the patient with Tracheostomy and were assigned the task of viewing a filmstrip/cassette program on care of the patient receiving Intravenous Therapy. The two lectures were constructed around the objectives and scripted statements contained within the filmstrip/cassette programs. The lecturer (who gave both the I.V. and the Trach lectures) was given an outline for the presentations but was allowed some latitude in pace and presentation order. In this way content was kept as uniform as possible between the two treatments. A diagram of the treatments follow:

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[9] Coopersmith, The Antecedents of Self Esteem, p. 18.

		Treatment	
		Lecture	Mediated Self-Instruction
CONTENT	Intravenous	Group A	Group B
	Tracheostomy	Group B	Group A

After viewing their respective lectures, the students were administered an objective test to measure their comprehension of the material which had just been presented to them. Students were also required to complete an objective test on the information presented to them in the required mediated self-instructional material. All viewing of media was completed in the School of Nursing's Learning Resources Center. Students were allowed to schedule their own time for viewing the mediated program and completing the objective test on that content.

Procedure

All students in the study were asked to complete a personal profile inventory which included the Dogmatism Scale (DS), the Internal-External Scale (IE) and the Self esteem Inventory (SEI). This 133-item instrument was administered to the students by their master instructor 2-3 weeks before the treatment was administered. Students were told that the purpose of the instrument was to assess the attitudes and values of junior-year nursing students. Students were assured that the results of the Inventory would be confidential and would in no way affect their grade in the course.

Treatment group "A" (N = 67) attended a 50-minute lecture setting forth the principles of caring for the patient receiving Intravenous Therapy. Immediately following the lecture a 21-item paper and pencil multiple choice exam was administered, testing the comprehension of that material by the students in that group. Group "B" (N = 92) attended a 50-minute lecture setting forth the principles of caring for the patient with a Tracheostomy. Following that lecture, a 27-item paper and pencil multiple choice exam testing that content was administered. Both lectures were given by the same School of Nursing instructor to reduce variance due to lecturer's style or personal charisma.

Groups A and B were assigned independent tasks, to be completed by the end of the semester (approximately 9 weeks after the lectures) in the School of Nursing Learning Resources Center. Group A, which had attended the lecture on I.V. Therapy, was assigned the task of viewing a mediated self-instructional filmstrip/cassette program on caring for the patient with a Tracheostomy. Group B, which had attended the lecture on Tracheostomy care, was assigned the task of viewing a mediated self-instructional filmstrip/cassette program on I.V. Therapy. Both groups were required to complete a paper and pencil multiple choice exam on the content transmitted through their respective filmstrip/cassette programs. After viewing the filmstrip/cassette program of Tracheostomy, Group A students were administered the same test as had been administered the Group B students after the lecture on that subject. Conversely, Group B students, after viewing the filmstrip/cassette program on I.V. Therapy, were administered the same test as had been completed by Group A after the intravenous therapy lecture. Viewing of the filmstrip/cassette programs was completed by the students on an independent basis throughout the course of the semester. Students would drop in to the LRC at any time and view the designated program on their own time and at their own pace.

Statistical Treatment

After the data had been collected, it was processed using the Statistical Package for the Social Sciences (SPSS).[10] A discriminant analysis was completed to assess any significant differences between the treatments (lecture and mediated self-instruction) and the existence of interactions between any of the variables under study (lecture, mediated self-instruction, dogmatism, locus of control and self-esteem).

The Statistical Null Hypotheses tested were:

1. There are no significant differences between the performance of the two treatment groups on a test of content detailing care of the patient with Intravenous Therapy.

2. There are no significant interactions between the performance of the two treatment groups on test of content detailing care of the patient with Intravenous Therapy and their scores on the DS, IE, and SEI.

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[10] N. H. Nie, D. H. Bent and C. H. Hull, Statistical Package for the Social Sciences (New York: McGraw-Hill, 1970).

3. There are no significant differences between the performance of the two treatment groups on test of content detailing care of the patient with a Tracheostomy.

4. There are no significant interactions between students' performance on tests of content detailing care of the patient with Tracheostomy and their scores on the SZI, DS, and IE.

ANALYSIS OF DATA

This chapter examines the data which were collected from the investigation of the research questions. The questions analyzed were:

1. Is there a significant difference between students' performance on tests of content taught through didactic, large group instruction and tests of content taught through mediated self-instruction?

2. Are there significant interactions between students' scores on the Dogmatism Scale, the Internal-External Scale, and the Self Esteem Inventory and students' performance on tests of content taught through mediated self-instruction or through large group lecture instruction?

Analysis of Hypotheses

The first and second hypotheses related to the treatment variables since they were used to present content detailing care of the patient receiving Intravenous Therapy. The statistical treatment used dictates that the first and second hypotheses be discussed simultaneously. The first hypothesis tested was: "There are no significant differences between the performance of the two treatment groups on a test of content detailing care of the patient with

Intravenous Therapy." The second hypothesis tested was: "There are no significant interactions between the performance of the two treatment groups on tests of content detailing care of the patient with Intravenous Therapy and their scores on the DS (Dogmatism Scale), the IE (Internal-External Scale), and the SEI (Self Esteem Inventory). A discriminant analysis was used to test these hypotheses. A series of analyses were accomplished, using the dependent variable as a dichotomous variable (pass/fail). These preliminary analyses narrowed the choice of independent variables to be included in the final analysis to the main effects only: Group, DS, IE and SEI. Past experiences in using the I.V. tests showed that approximately 25 percent of the subjects completing this test would fail it the first time administered. Therefore, the PRIORS option in the SPSS program was utilized to enter such parameters into the analysis. The discriminant analysis of the I.V. data yielded is shown in Table 1. Wilk's Lambda and F ratios were calculated separately on each of the four independent variables to assess their strength as discriminators and the statistical significance of that strength (d.f. = 1 and 157) is shown in Table 2. The significant F ratios of Group and SEI indicate that those two variables separately may assist in classifying subjects to one of the categories of the dependent variable (pass or fail).

Further analysis of the data yielded is shown in Table 3. The Standardized Canonical Coefficients of Group (.6431) and SEI (-.6222) point to those two variables as being significant factors in classifying subjects to one of the categories of the dependent variable.

Table 1

Group Means and Standard Deviations
Intravenous Therapy Variable

		Group	DS	IE	SEI
Failed	($\bar{X}$)	0.571	16.024	12.214	34.405
	(SD)	0.501	4.598	3.695	9.308
Passed	($\bar{X}$)	0.367	14.658	11.692	37.906
	(SD)	0.484	5.123	3.861	7.104
Grand Mean		0.421	15.019	11.830	36.981
	(SD)	0.495	5.163	3.804	7.870

Table 2

Tests of Significance: I.V. by
Group, DS, IE and SEI

Variable	Wilks' Lambda	F	Significance
Group	0.9668	5.382	0.0216
DS	0.9863	2.179	0.1419
IE	0.9963	0.580	0.4473
SEI	0.9613	6.324	0.0129

Table 3

Discriminant Analysis of Intravenous Therapy Variable

Variable	Standardized Canonical Coefficients	Pooled Within-Groups Correlations
Group	0.6341	-0.7448
DS	0.2231	0.6872
IE	-0.0126	0.4372
SEI	-0.6222	0.2256

The Standardized Canonical Coefficient and Pooled Within-Groups Correlation of the variable Group reveal the significance of differing instructional methods in this study. Table 4 shows the direction of the independent variables' relationship to the dependent variable. In this analysis it is determined that the students who received the instruction through lecture method were more likely to fail the test of I.V. content. Therefore, Hypothesis 1 was rejected.

An analysis of the combined variables on function 1 (I.V. scores) is shown in Table 5. The analysis in Table 5 shows a significant discriminating power in the four independent variables used in the analysis. Although these variables are relatively weak discriminators (Wilks' Lambda being an inverse measure of the percentage of variance explained by the independent variables used in the

Table 4

Group Centroids
Intravenous Therapy
Variable

Group	Function 1
Failed	0.4469
Passed	-0.1604

Table 5

Canonical Discriminant Function:
Intravenous Therapy Variable

Function	Wilks' Lambda	Chi-square	df	Significance
1	0.9323	10.863	4	0.0281

analysis), their ability to classify subjects into correct groups is statistically significant. This is confirmed by the classification results shown in Table 6. Table 6 indicates that no cases were predicted to fall in the "failed" (0) category. The fact that 42 of the 159 subjects did fail yielded the noted classification percentage.

The two groups in this analysis met the necessary assumption of homogeneity on a test of Equality of Group Covariance Matrices.

Analysis of the first and second hypotheses through the use

Table 6

Classification Results
Intravenous Therapy
Variable

Actual Group	Number of Cases	Predicted Group Membership	
		0	1
0	42	0	42
1	117	0	117

Percentage of "grouped" cases correctly classified: 75.47%

of discriminant analysis revealed a significant ability of the variables Group and SEI to classify subjects into a category of the dependent variable. In this analysis it may be predicted that a subject assigned to Group One (lecture) is more likely to fail the test on caring for the patient receiving Intravenous Therapy. Subjects with high scores on the SEI are more likely to pass this test. Thus, the null hypothesis in Hypothesis 2 was rejected.

Although the scores of the dependent variable in this analysis make it appear to be a continuous measure, these tests were designed for mastery learning and the students' ability to pass the test at the 70 percent level was the only measure recorded. Actual tests scores were not considered in this evaluation. To analyze this data as if it were continuous, a multiple regression analysis was accomplished. No statistically significant findings were obtained.

The third and fourth hypotheses related to the treatment variables as they were used to present content detailing care of the patient with a Tracheostomy. The statistical treatment used dictates that the third and fourth hypotheses be discussed simultaneously. The third hypothesis tested was: "There are no significant differences between the performance of the two treatment groups on a test of content detailing care of the patient with a Tracheostomy." The fourth hypothesis tested was: "There are no significant interactions between the performance of the two groups on tests of content detailing care of the patient with a Tracheostomy and their scores on the DS, IE, and SEI." A discriminant analysis tested these hypotheses. A series of analyses was completed, using the dependent variable as a dichotomous variable (pass/fail). These preliminary analyses narrowed the choice of independent variables to be included in the final analysis to the main effects (Group, DS, IE, and SEI) and the first order interactions with Group, (GDS, GIE, and GSEI). Past experience in using the Tracheostomy test showed that it was probable that approximately 25 percent of the subjects completing this test would fail it the first time it was administered. Therefore, the PRIORS option in the SPSS program was utilized to enter such parameters into the analysis.

The discriminant analysis of the Trach data yielded is shown in Table 7. It should be noted that the standard deviations, especially in GDS, GIE, and GSEI are very large, in some cases surpassing the group means. These unexpected standard deviations may have resulted

Table 7

Group Means and Standard Deviations
Tracheostomy Variable

		Group	DS	IE	SIE	GDS	GIE	GSEI
Failed	($\bar{X}$)	0.316	14.316	11.263	34.632	4.053	4.579	8.843
	(SD)	0.478	4.295	3.429	11.786	6.249	7.042	15.082
Passed	($\bar{X}$)	0.435	15.114	11.907	37.300	6.750	5.136	16.100
	(SD)	0.498	5.275	3.857	7.180	8.335	6.356	18.927
Grand Means		0.421	15.019	11.830	36.981	6.427	5.069	15.233
	(SD)	0.495	5.163	3.804	7.870	8.145	6.447	18.613

in part from the fact that the two treatment groups did not prove to be homogeneous. On a test of Homogeneity of Group Covariance Matrices a significant difference was revealed between the two groups. Thus, the two groups did not meet the assumption of statistical equivalence postulated in the sampling procedure. The implications of this finding will be discussed later in this chapter.

Wilks' Lambda and F ratios were calculated separately on each of the four independent variables and the three first order interactions with Group to assess their strength individually as discriminators and the statistical significance of that strength (df = 1 and 157).

Table 8

Tests of Significance: Trach and Independent Variables

Variable	Wilks' Lambda	F	Significance
Group	0.9938	0.9805	0.3236
DS	0.9975	0.3987	0.5287
IE	0.9970	0.4779	0.4904
SEI	0.9879	1.9350	0.1662
GDS	0.9884	1.8450	0.1763
GIE	0.9992	0.1241	0.7251
GSEI	0.9839	2.5690	0.1110

An F value of 3.91 is required for statistical significance; none of the above approached that level. Therefore, none of these seven variables individually discriminated to the dependent variable.

Further analysis of the data yielded the following:

Table 9

Discriminant Analysis of Tracheostomy Variable

Variable	Standardized Canonical Coefficient	Pooled Within-Groups Correlattions
Group	-0.6276	0.2391
DS	-0.1453	0.1525
IE	0.7347	0.1669
SEI	0.1388	0.3358
GDS	1.7573	0.3279
GIE	-1.9714	0.0851
GSEI	2.1537	0.3870

The Standardized Canonical Coefficients and Pooled Within-Groups Correlations of the variables Group, SEI, GDS and GSEI point to these four variables as being factors in the classification of subjects to the two groups of the dependent variable. Although the Standardized Canonical Coefficient of Group was high (-0.6276), the Pooled Within-Groups Correlation (0.2391) was too low to engender any confidence in its ability to discriminate subjects to the dependent variable. Therefore, Hypothesis 3 was retained.

Table 10 illustrates the direction of the relationship between the categories of the dependent variable and the discriminating independent variables.

Table 10

Group Centroids Tracheostomy Variable

Group	Function 1
Failed	-0.8917
Passed	0.1210

The three independent variables which have shown significant strength of discrimination and correlation (SEI, GDS and GSEI) all discriminate to the "passed" category of the dependent variable.

An analysis of the group means of the interaction variables show the differences among the two groups in their performance on the dependent variable measure is shown in Table 11. Table 11 shows a considerable difference between the two treatment groups in their performance on the SEI. There is also a noticeable difference between the scores of the "failed" group and the scores of the "passed" group within each treatment group. Students with high scores on the SEI who received this instruction through mediated self-instruction were more likely to pass the achievement test, while students with high scores on the SEI who received this instruction through a lecture were more likely to fail the achievement test. Conversely, students

Table 11

Tracheostomy Variable
Group Means: Group/SEI

	Mediated Self-Instruction	Lecture	GSEI
Failed	8.842	25.790	34.632
	(n = 6)	(n - 13)	(n = 19)
Passed	16.100	21.200	37.300
	(n - 61)	(n - 79)	(n - 140)
Grand Means	15.450	21.849	36.981
	(n - 67)	(n = 92)	(n = 159)

with low scores on the SEI would be expected to fail in the mediated self-instruction method and pass in the lecture method of instruction. Table 12 shows the difference in the performance of the two treatment groups in their performance on the DS. Students with high DS scores who received their instruction through mediated self-instruction were more likely to pass the achievement test while those students with high DS scores assigned to the lecture group were more likely to fail the Tracheostomy test. Conversely, low DS students in mediated self-instruction were more likely to fail, while low DS scores would seem to predict success in the lecture method of instruction.

Table 13 presents an analysis of the combined variables on Function 1 (Tracheostomy scores):

Table 12

Tracheostomy Variable
Group Means: Group/DS

	Mediated Self-Instruction	Lecture	GDS
Failed	4.053	10.263	14.316
	(n = 6)	(n - 13)	(n = 19)
Passed	6.750	8.364	15.114
	(n - 61)	(n = 79)	(n = 140)
Grand Means	6.508	8.632	15.019
	(n = 67)	(n = 92)	(n = 159)

Table 13

Canonical Discriminant Function
Tracheostomy Variable

Function	Wilks' Lambda	Chi-square	df	Significance
1	0.9015	15.919	7	0.0259

Table 13 shows significant discriminating power in the four independent variables and the three first order interactions with Group. The Standardized Canonical Coefficients, along with their associated Pooled Within-Groups Correlations, point to four variables (Group, SEI, GDS and GSEI) as contributing the greatest amount to the discriminating ability of the total. Although these varialbes are weak discriminators (Wilks' Lambda = 0.9015), their ability to classify subjects into correct groups is statistically significant. This is confirmed by the classification results:

Table 14

Classification Results
Tracheostomy Variable

Actual Group	Number of Cases	Predicted Group Membership	
		0	1
0	19	3	16
1	140	3	137

Percent of grouped cases correctly classified: 88.05%

Table 14 indicates that six cases were predicted to fall in the "failed" (0) category. In this study 19 students actually failed, yielding a classification success percentage of 88.05%.

The result of this analysis is that Hypothesis 4 is rejected. Analysis of the data revealed a significant ability of the four independent variables and the three first order interactions with Group to classify subjects into categories of the dependent variable. Particularly important discriminators in this analysis were the main effect variable SEI and the interaction variables GDS and GSEI.

Subjects with high scores on the SEI were more likely to pass the Tracheostomy test. Those subjects with higher scores on the DS and SEI who were assigned to treatment group one (mediated self-instruction) would also be expected to perform quite well on the Tracheostomy test. Conversely, those students with lower scores on the DS and SEI who were assigned to the lecture treatment would be expected to perform less well on the Tracheostomy test.

Although the scores of the dependent variable in this analysis make it appear to be a continuous measure, these tests are designed for mastery learning and the students ability to pass the test at the 70% level is all that is recorded. Actual test scores are not considered in this evaluation. To analyze the data as if it were continuous, a multiple regression analysis was accomplished. No statistically significant findings were obtained.

Discussion of Findings

The following hypotheses were stated and tested:

1. There are no significant differences between the pass/fail performance of the two treatment groups on a test of content detailing care of the patient with Intravenous Therapy.

2. There are no significant distinguishing interaction characteristics for those passing or failing a test of content detailing care of the patient with Intravenous Therapy and their scores on the Dogmatism Scale (DS), the Internal-External Scale (IE) and the Self-Esteem Inventory (SEI).

3. There are no significant differences between the pass/fail performance of the two treatment groups on a test of content detailing care of the patient with a Tracheostomy.

4. There are no significant distinguishing interaction characteristics for those passing or failing a test of content detailing care of the patient with a Tracheostomy and their scores on the DS, IE and SEI.

All four hypotheses were tested through a discriminant analysis. In the first hypothesis, it was discovered that within the discriminant analysis the method of instruction was a significant factor in classifying subjects to categories of the dependent variable. The students who learned through the mediated self-instruction method were more likely to pass the I.V. test than those in the lecture group. This was an unexpected finding, as many previous studies had found no significant differences in the comparison of these two types of instruction. Thus, Hypothesis 1 was rejected.

In the second hypothesis, a significant relationship was found between students' performance and their scores on the Self Esteem Inventory. High scores on the SEI would seem to predispose the student to higher achievement on the test of content detailing care of the patient receiving Intravenous Therapy. However, no significant distinguishing interaction characteristics were discovered, so Hypothesis 2 was retained.

In the third hypothesis, a very weak relationship was found between instructional method and student performance within the discriminant analysis. The low correlation of this relationship caused Hypothesis 3 to be retained.

In the fourth hypothesis, it was found that the main effect variable, SEI, and the interaction variables GDS and GSEI, were effective discriminators to the Trach variable. Thus, Hypothesis 4 was rejected.

Conclusion

The two parallel studies described above identified conflicting information as to the effectiveness of the the two treatments. The analysis of data used to test Hypothesis 1 found that students assigned to the mediated self-instruction group performed significantly better on a test of I.V. content than did students assigned to the lecture method. The analysis of data used to test Hypothesis 3 identified an advantage for the students assigned to the mediated self-instruction group. However, this advantage was not significantly significant. This was an unexpected result, as the treatment groups were identical and the instructional presentations were as identical as possible. The only difference between the two studies was the topic of the presentation. The differing results may be attributed to the variance of the dependent variable (Tracheostomy), or may be a result of the lack of homogeneity of the two sample groups. The conclusion one may draw from this analysis is that there may be instances when mediated self-instruction is a more effective method of instruction than lecture.

The analysis of Hypothesis 2 and Hypothesis 4 revealed a main effect between instructional method and personality traits. In both analyses the SEI trait was a significant discriminator of students to the "pass" category of the dependent variable for those students who had received their instruction through the media. In both instances students with higher SEI scores were more likely to pass the measures of the dependent variable. The analysis of Hypothesis 2 revealed no interaction characteristics among the personality trait measures. In Hypothesis 4, the variables GDS (Group X Dogmatism Scale) and GSEI (Group X Self Esteem Inventory) revealed an ability to classify students receiving instruction through mediated self-instruction to the proper category of the dependent variable Trach. Students assigned to Group "A" (mediated self-instruction) with higher scores on the DS and SEI were more likely to pass the test of Tracheostomy content than those in the same group with low DS and SEI scores. It is not unexpected that the interaction variable GSEI should be found significant, as it is derived from two main effect variables found to be significant in the discriminant function.

Less expected was the significance of GDS (Group X Dogmatism) in the discriminant function. Analyzed separately, the DS variable had a negative weight and a low correlation. However, when combined with Group in the interaction variable GDS, the two became a significant discriminator in the analysis. Thus, it may be supposed that the interaction of two or more independent variables can contribute to the classification of subjects into a category of the dependent variable.

The single major conclusion of this study is that an analysis of the interactions between personality traits and type of instruction can assist the teacher in assigning the student to an instructional treatment resulting in the greater likelihood that the learning will be successful for that student.

An Investigation of Technological Innovation:

Interactive Television

Presented in a Symposium:

Application of Media Technologies for Naturalistic Research

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An Investigation of Technological Innovation: Interactive Television

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Introduction

According to Curtis and Biedenbach (1979, p.3), "Many critics believe that education is the only major American industry which does not yet make intensive use of modern technologies to reduce its costs and to increase the scope of its services." A project begun in Illinois in August, 1983 is an attempt to utilize new and emerging technologies to increase the effectiveness of the educational process. This project, the Carrol Instructional Television Consortium, was the first cooperative educational program of its kind in Illinois, and was born of the common need of four small rural high schools to offer a full range of academic opportunity to their students.

The Consortium utilizes a cable television network already serving the four districts. The system permits simultaneous video and audio communication between any or all of the four high schools. An instructor in one of the four schools teaches class as they normally would, except there are cameras, microphones and monitoring equipment in their classroom. In the other three schools, students watch the lesson and listen to the instructor on their own monitors, while being seen and heard by the instructor as well as by their counterparts in other schools. The two-way television consortium represents a technologically acceptable method for sharing instructional resources, better utilizing faculty expertise and more fully serving the academic needs of the students.

The project goals of the Carrol Instructional Television Consortium are:

1. To increase the total number of course offerings available to students enrolled in the participating districts.
2. To provide fully qualified, experienced, and effective faculty to teach advanced level course work in mathematics, science and foreign languages.
3. To motivate and challenge talented and gifted students through association with comparable students from other districts.
4. To promote high levels of student achievement as measured by content mastery of advanced level course work.
5. To increase the efficiency of teacher instructional time in traditionally low enrollment advanced level curricular offerings.

Based initially on these goals, project evaluation was designed as a five year process. The research has broadened some to include many factors of the environment, and to be as complete as possible.

Project evaluation of this scope has inherent many problems. The subjectivity of observation, the lack of control of population or teaching methods, the gaps in communication or cooperation all prevented the researcher from utilizing experimental research procedures which would add more data to the "N.S.D." comparative studies literature. Instead, the design of this research was based on naturalistic research premises; the outcomes will be non-statistical but rich data about the school environment and the project's success. This study employs a naturalistic paradigm to investigate a technologically innovative project using two-way interactive television as a vehicle to enhance curriculum.

Very few projects involving interactive television have been researched to date, as the technology is fairly recent. Interactive projects in Trempeauleau County, Wisconsin and at Texas A & M University have resulted in some study reports (Hartz, 1983; Johnson, 1983) which detail the utilization of the technology and its success. Project reports show "preliminary" data, and show no significant difference between live and interactive televised instruction in cognitive growth.

The Carroll I.T.V. Consortium modeled itself in part after the Trempeauleau County project. Evaluation reports from Wisconsin were available in the design of the research for this project.

The previously listed Project Goals are the focus of the research. In order to evaluate whether the five goals have been achieved, research objectives and data collection methods were directed at the goals as well as at more general research objectives.

Purpose

This paper explains the Carroll Instructional Television Consortium, the design of the research being conducted to evaluate the project, and the results evident from data collected to date.

Objectives of the Study

This study was designed to determine:

1. Is an interactive television system effective?
2. Is the teaching/learning process affected by use of interactive television?
3. Is the interactive television system accepted by the teachers, the students, and the school districts?
4. Are the project goals successfully met?

Methodology

A case study was designed to intensively study the status and interaction of the participants and this project. Data is being collected using several different techniques:

1. Student cognitive growth is measure by pre- and post-tests in their subject matter.
2. Students are surveyed four times during the year to evaluate technical aspects of the system.
3. Teachers are observed throughout the year, approximately 75 hours in total.
4. Administrators involved in the innovation are interviewed about their decision-making process and their satisfaction with the project.

The case study methodology inlcudes many separate data collection techniques, as listed. More specifically, evaluation and data collection includes:

1. A comparison of 1984-85 course offerings with 1983-84 course offerings in each participating district by the district

administrator and researcher.

2. Periodic assessments of teacher effectiveness by district administrators and the researcher.
3. A survey of student opinion about teacher effectiveness conducted by the researcher during each quarter of the academic year.
4. A survey of student attitudes and satisfaction conducted by the researcher during the fourth quarter of the academic year.
5. A survey of teacher opinions about student motivation and degree of challenge conducted by the researcher during the fourth quarter of the academic year.
6. Teacher-made tests covering learner objectives identified in course outlines utilized for entry and exit level assessments of student mastery of course content.
7. Analyses of student achievement scores made by the researcher to assess: 1) student growth, and 2) comparison of achievement scores for students located at originating site with those located at remote sites, and with those not in TV classes where available.
8. A comparison made by district administrators of enrollments in the televised classes with enrollments in the same classes taught in individual districts during the previous two years.

Thus, the data collection has been triangulated to include pre- and post-tests, student/teacher surveys, and observation and interviews throughout the project. Guba (1981) suggests that triangulation can improve dependability and transferability of data collected in naturalistic inquiry. The trustworthiness of observation and interview data can be enhanced by the collection of survey and cognitive growth data, and by the comparison of results gathered by all three methods.

Further explanation of each data source should provide a clearer understanding of the triangulation of data collection.

Two goals of the Carroll Instructional Television Consortium were administrative in nature: to increase total number of course offerings in the four schools and to increase teacher instructional time efficiency. With high school populations under 200, the total number of courses offered each year is limited. Each administrator provided the number of classes offered per school and the teacher assignments, and provided any "paper trail" of course selection procedures and class assignments (meetings with counselors, teachers, and students). Thus, administrator information documented the change in total number of courses available and in teacher/student ratio indicating teacher efficiency.

A third goal of the project was to provide advanced students with effective, experienced teachers. Some schools had no qualified foreign language or business teachers, and others had no fully qualified advanced science teacher. In order to evaluate teacher effectiveness over the system, an observation instrument and schedule were developed. Teachers received five days of in-service training prior to the initiation of the system, and discussion during those sessions was utilized to help develop the teacher observation instrument. Also, materials from a variety of teacher observation forms were utilized as a guide to rating effective teaching techniques (Salome, 1977). Elements of teaching effectiveness via television were drawn from reports of T.V. teaching studies (Hartz, 1983) and from observation during practice sessions over the system equipment itself. Since teachers were concerned about student perceptions of the course instruction, especially the opinions of "distant" students, questions were added to the student survey dealing with content presentation and teacher accessibility. Interviews with administrators included teacher effectiveness ratings.

The last two goals of the project involved the real beneficiaries of the system-the students. These goals were to motivate and challenge talented students through enhanced opportunities to interact in upper level courses with other advanced students, and to promote high levels of achievement among these students. In order to collect data related to student motivation, questions were added to the observation instrument, the student survey, and all interview instruments. Pre- and post-tests were designed to indicate levels of student achievement, and to facilitate comparison between student achievement, both in televised and non-televised classes where available, and between on-site and "distant" students in any given class. Pre- and post-tests were developed by the classroom teachers, and were often similar to or the exact final exam given normally in the course. Teachers administered these exams during the first and last week of classes to all their television students, and to non-television classes where available.

To summarize, project goals were used to direct data collection methods. Where possible, triangulated methods were designed to collect data using more than one method. Observation, survey, and interview were all selected to provide the richest possible data collection and to improve dependability and transferabilty of data collected. All instruments were developed by the researcher and project participants utilizing discussions, notes from in-service training, and earlier project reports to generate some elements of the instruments.

Results

Results are discussed based upon project goals. Only preliminary data is available, since evaluation will continue throughout the initial five-years of the project. The first year's data has been collected and partially analyzed based upon the project goals and study objectives listed previously. Data was collated from all three sources, and the strength of the data across sources was one area analyzed. However, the first year's data is inconclusive alone, and no statements as to the project's success should be inferred from this preliminary year.

Project Goals:

A) Increase course offerings and teacher efficiency.

Each administrator reported the number of course offerings available to their students. The largest school increased only in number of sections of a course; no new courses were added. The other three schools increased their course offerings by one to three courses per school, with the smallest school increasing the most. Teacher effiency was increased in each school. Instructional time for small classes (3-6 students) was judged as inefficient in previous years. All schools increased class sizes or teacher/student ratio by adding students from the other three schools to the student population "pool" for advanced classes.

B) Provide students with effective teachers.

Teacher effectiveness was extremely important to the project. Teachers were selected by their administrators based upon their years of experience, professional preparation, personality or teaching style, and willingness to participate. In-service activities focussed on mastery of the television equipment and adaptation of lesson plans to television. Teacher effectiveness in the first year was evaluated based upon observation, interview, and the student survey. (See Appendix I for observation instrument and student survey.)

Observation data indicated that the teachers were effective in managing the television equipment, materials distribution, and course structure in their televised classes. Observation of each teacher focussed on their use of the system and their teaching style, class organization, and communication abilities such as eye contact, questioning and feedback. Teachers were rated on these elements, and the ratings indicated growths and improvement throughout the year.

The student survey indicated satisfaction with teacher effectiveness (See Appendix 2). On a 1 = poor to 5 = excellent scale, teacher effectiveness and accessibility were rated by students. Improvement was noted, especially in accessibility (from an average of 3.45 in October to 4.29 in April). Ease of comprehension of material presented was rated an average of 3.72 in October and 3.77 in April, so some improvement was noted. Teacher and student interviews revealed a wide range of satisfaction with teacher effectiveness, much of which varied from school to school and resulted from technical systems operation problems and student opinions of the system rather than the teacher. Interview data was the most interesting but was also the most difficult to collate, as personalities and indivdual grades etc. affected the evaluation of effectiveness.

Teacher effectiveness was perceived by all three data sources to be above average. However, teacher effectivenss is extremely difficult to evaluate, and the data has not been completely collated.

C) Motivate students and promote high levels of achievement.

Student motivation was indicated by observation and interview. No observed comparisons to student motivation in regular classrooms were available, but participants were asked to compare regular to televised classes.

Motivation was indicated by participation and by ease of understanding on the student survey (Appendix 2). These two elements averaged at 3.49 and 3.77 respectively in April. These figures indicate that students felt their participation was only average, but that their comprehension was above average by the end of the school year.

Student achievement data was collected using all three methods. The pre- and post-test scores were somewhat inconclusive, due to some problems of administration and scoring. However, average class "gains" in scores on the test indicated that students were learning, and that in several classes, students in "distant" classrooms improved more than those in the teachers' own school. Individual gain and average class gains for each class were recorded for future comparisons. In the second year, comparisons with non-televised classes will also be available.

In summary, preliminary results have indicated:

1. Student evaluations of technical considerations showed that the system itself improved during the first year;
2. Teachers improved in both effectiveness and efficiency throughout the year;
3. Administrators and other faculty perceptions showed increased satisfaction with the system in the first year;
4. Students in remote interactive television classes achieved as well on the post-test as students in live classrooms.

Discussion/Summary

This research was designed as a five year case study, to intensively analyze the status and interaction of the project and its participants. The objectives of the study were to determine 1) the effectiveness of the system; 2) the effect of the system on the teaching/learning process; 3) the level of acceptance of interactive technology, and 4) the success of the project.

The use of naturalistic inquiry in pursuing these objectives provided for the collection of data in a triangulated design. Data collection has proceeded with all three sources of data providing in-depth and detailed results. Observation has proven the richest source of data; pre- and post-tests were the least reliable source in the first year.

The instruments and their method of administration were altered for the second year of data collection. More questions were added to the student survey, and the researchers had better control of the testing process. These changes should improve the quality and quantity of data collection.

Naturalistic inquiry is a process, not a static technique. Research utilizing multiple data collection techniques including observation has particular strengths and weaknesses. As a methodology, naturalistic inquiry will not definitively prove that this sytem is more effective than a live teacher, or that interactive television is better than or less effective than other instructional delivery systems. The cognitive growth of individual students measured using more sytematic methods would be more quantifiable.

The advantage of this inquiry technique is that it is a process. Much is learned during the data collection about the techniques employed. The quantity and detail of data collected is extraordinary, and the possibilities for collating and reporting are challenging. The study herein describe should provide reliable, detailed data addressing the four objectives. The richness of the data will provide even more than is required for the continuation of the project, and will certainly establish the level of success of the project relating to its five project goals.

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Appendix I
Part 1

MEMORANDUM

TO: TV Students - Chadwick, Lanark, Milledgeville and Shannon

DATE: May, 1984

RE: Evaluation of system

Now that the television system has been operational for close to a year we would appreciate an evaluation of your experience taking a course via this method.

Please rate on a scale of 1-5
(1 = poor, 2 = below average, 3 = average, 4 = above average, 5 = excellent)

Make additional comments you care to.

Course:____________________ Instructor:____________________

Your school:____

1. Was the reception of the picture good enough for following the lecture, copying materials, etc?

________ (1-5)

2. Was the audio satisfactory?

________ (1-5)

3. Do you feel that the talkback feature allowed you to participate effectively in the class?

________ (1-5)

4. Was the instructor accessible to you outside of regular class time?

________ (1-5)

5. Have you been receiving hand-outs, and other materials form the instructor in time for assignments?

________ (1-5)

6. The material presented in this class has been as easy to follow as material presented in regular face-to-face classes?

________ (1-5)

7. Additional comments.

Appendix I
Part 2

Evaluation of Teaching Performance over Interactive Television

Evaluator ____________________ From what site ____________________

Teacher ____________________ Class originates ____________________

Class ____________________ Date ____________________

Section 1 - Equipment (system) evaluation

Low — High

1. Is starting class a problem because of equipment set-up. 1 2 3 4 5

2. Does the teacher run an audio and video check before class. 1 2 3 4 5

3. Are there problems with audio? Yes No

4. If yes, please describe.

____

____

5. Are there problems with video? Yes No

6. If yes, please describe those problems.

____

____

7. Does the teacher make effective use of the special effects generator (SEG). 1 2 3 4 5

8. How could the teacher make better use of the SEG?

____

____

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		Low				High
9.	Does it appear any part of the system is interfering with the teaching/learning process.	1	2	3	4	5

10. Please discribe how the system is interfering with the teaching/learning process if applicable.

____

____

11.	Does it appear the students are reluctant to participate in class because of the system?	1	2	3	4	5
12.	Are the students capable of "trouble-shooting" the system?	1	2	3	4	5

13. If not, what are some of the problems the students are encountering, and at what site?

____

____

****

Section 2 - Instructional style

How does the teacher come across on the system.

14.	Personal traits - projects tack, patience, freedom from mannerisms, etc.	1	2	3	4	5
15.	Voice - clearness, decisiveness, pleasantness	1	2	3	4	5
16.	Language usage - oral English, handwriting, spelling	1	2	3	4	5

Content skills

17.	Knowledge of subject, knowledge of field, ability to develop ideas.	1	2	3	4	5
18.	Planning learning activities - development of objectives in terms of pupils growth in knowledge and understanding of subject.	1	2	3	4	5
19.	Teaching techniques -organization of subject matter, stimulation of student learning.	1	2	3	4	5

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		Low				High
20.	Presentation skills - recognition of individual differences, variety of techniques, clarity.	1	2	3	4	5

Did the instructor use good personal techniques for:

21.	gaining and holding attention	1	2	3	4	5
22.	questioning	1	2	3	4	5
23.	reinforcing	1	2	3	4	5
24.	clarifying and explaining	1	2	3	4	5
25.	giving directions	1	2	3	4	5
26.	use of student ideas	1	2	3	4	5
27.	physical (eyes, voice, language, lack of tension, enthusiasm, movement)	1	2	3	4	5
28.	Did the instruction fit the time constraints.	1	2	3	4	5
29.	Were there clearly defined objectives.	1	2	3	4	5
30.	Were the objectives meet?	1	2	3	4	5
31.	Was there effective closure?	1	2	3	4	5

Section 3 - Misc.

32.	Does it appear the teacher is available to work with the students after class?	1	2	3	4	5
33.	Did the instructor use supplemental materials?	1	2	3	4	5
34.	Did the instructor allow students to participate in class?	1	2	3	4	5
35.	Is too much time being spent on record keeping?	1	2	3	4	5
36.	Does teacher take time to explain complex concepts?	1	2	3	4	5

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37. How long was this class (in minutes) ____________________

38. Approximately how much dead time is there? (no instruction before, during and after class). ____________________

39. Were there unusual or creative touches which caused the teacher to stand out?

____

____

____

40. Other comments.

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Overall-Summary
10/25/83

1. Was the reception of the picture good enough for following the lecture, copying materials, etc.? 3.9
2. Was the audio satisfactory? 3.1
3. Do you feel that the talkback feature allowed you to participate effectively in the class? 3.8
4. Was the instructor accessible to you outside of regular class time? 3.6
5. Have you been receiving hand-outs, and other materials from the instructor in time for assignments? 4.4
6. The material presented in this class has been as easy to follow as material presented in regular face-to-face classes. 3.9

Comments:

In general, the majority of the students enjoyed and found the class interesting; allowing them to experience a broader curriculum.

The most common of negative feedback was that there are problems with the audio and picture reception at times.

Other comments included; the need for another Spanish educated person, other than the instructor, in the class and that the program should be used for smaller classes with approximately eight students at the maximum.

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Overall-Summary
(Teacher Present)
10/25/83

1. Was the reception of the picture good enough for following the lecture, copying materials, etc.? 3.7

2. Was the audio satisfactory? 3.3

3. Do you feel that the talkback feature allowed you to participate effectively in the class? 3.3

4. Was the instructor accessible to you outside of regular class time? 4.4

5. Have you been receiving hand-outs, and other materials from the instructor in time for assignments? 4.3

6. The material presented in this class has been as easy to follow as material presented in regular face-to-face classes. 3.5

Overall-Summary
(No Teacher Present)
10/25/83

1. Was the reception of the picture good enough for following lecture, copying materials, etc.? 4.1
2. Was the audio satisfactory? 3.1
3. Do you feel that the talkback feature allowed you to participate effectively in the class? 4.3
4. Was the instructor accessible to you outside of regular class time? 3.3
5. Have you been receiving hand-outs, and other materials from the instructor in time for assignments? 4.4
6. The material presented in this class has been as easy to follow as material presented in regular face-to-face classes. 4.1

Appendix I
Part 3

CARROLL INSTRUCTIONAL TELEVISION CONSORTIUM

Student Survey
1984 - 35

Your School ______________________

Instructor ______________________

Course ______________________

Did you take a TV course last year?

☐ Yes

☐ No

****

Please rate the following questions on a scale of 1 - 5 (1=poor, 2=below average, 3=average, 4=above average, 5=excellent), and make any additional comments you care to.

1. What was your opinion of the TV classes before this class?

   ☐ no opinion ☐ poor idea ☐ average idea ☐ above average idea

2. Why did you have that opinion? ______________________________

   ____

3. Was the reception of the picture good enough for following the lecture, copying materials, and taking notes? ______(1-5)

4. Can you hear the instructor, and the students in the other schools? ______(1-5)

5. Do you feel that the talkback feature allowed you to participate as effectively in this class as in regular classes? ______(1-5)

6. Do you feel as comfortable learning from the TV teacher as you do from a teacher in a regular class? ______(1-5)

7. Is the teacher accessible to you outside of regular class time? ______(1-5)

   Please describe when and how the teacher is accessible to you.

   ____

8. Do you feel you have an opportunity to get to know your classmates from the other schools as well as you get to know your classmates in a regular class? ______(1-5)

9. Have you been receiving hand-outs and other materials from the teacher in time for assignments? ______(1-5)

Over please

10. Do you feel the material presented in this class has been as easy to follow as material presented in regular classes? ________(1-5)

11. How well do you like the TV class? ________(1-5)

12. In general, how well do you like school? ________(1-5)

Are there any additional comments you would like to make?

____

____

____

____

Thank you for your time and effort.

Please return this survey to your teacher.

Appendix II

STUDENT FEEDBACK/ASSESSMENT

An evaluation of the television system was administered to participating students 3 times during the academic year (1983-84). Each time they were asked to respond to 6 questions concerning logistical and technical considerations of the system. Using a scale of 1 - 5 (1=poor, 5=excellent) they were asked to rank each question. The following are the questions and their corresponding results.

Question #1

Was the reception of the picture good enough for following the lecture, copying materials, etc.?

October	February	April
3.85	3.59	3.70

Question #2

Was the audio satisfactory?

3.13	3.20	3.49

Question #3

Do you feel that the talkback feature allowed you to participate effectively in the class?

3.67	3.35	3.49

Question #4

Was the instructor accessible to you outside of regular class time?

3.45	3.58	4.29

Question #5

Have you been receiving hand-outs, and other materials from the instructor in time for assignments?

4.24	4.29	4.69

Question #6

The material presented in this class has been as easy to follow as material presented in regular face-to-face classes?

3.72	3.46	3.77

A RHETORICAL AND STRUCTURAL ANALYSIS OF INSTRUCTIONAL TELEVISION

by
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Introduction

As an area of instruction, social studies has been considered unsatisfactory. The amount of time spent in teaching social studies is far less compared with reading and mathematics (Department of Public Instruction, 1982), social studies lack uniformity and predictability (Superka, Hawke and Morrissett, 1980), and teachers use textbooks most of which are well over five years old as their bases for reading, discussion and evaluation (Shaver, Davies and Helburn, 1979). With the ever present textbook in the classroom, the most extensively used instructional practices in social studies are lecture and discussion (Superka, Hawke and Morrissett, 1980).

Given the state of social studies teaching across the United States, the Wisconsin Department of Public Instruction (or DPI) conducted a survey to identify the needs of social studies teachers in Wisconsin. Among other things, this survey identified the need for an in-school television resoource series for middle schools. It was on the basis of this expressed need that the Wisconsin Educational Television Network and the Agency of Instructional Television (AIT) funded planning and production of a world culture series. This world culture series subsequently called ACROSS CULTURES,was the subject of this study.

In the area of global education, teachers can use television to help students develop inferences about the concept of culture. However, reading a television on world cultures from a geographical and cultural distance can be problematic. The possibility of "domesticating" foreign cultures is real because what is alien tends to be translated into the familiar. Is it possible to understand the meaning of a television presnetation on foreign cultures as contexted in its own terms?

The use of a television documentary to help teach concepts of world cultures is new. ACROSS CULTURES is a pioneering effort in this regard. It would be instructive to find out if the communicators of ACROSS CULTURES achieved their objectives and to analyze the methods used to to communicate intended concepts.

Statement of the Problem

ACROSS CULTURES was produced in response to the need of social studies teachers for a television series that cover world culture topics. What were the stated objectives of the communicators of ACROSS CULTURES? How was ACROSS CULTURES structured to attain these objectives? This study attempted to address these questions.

Related Literature

From its very inception, cinema can be seen as divided into two main categories which remain essentially the same even today: the realistic film or the documentary and the fiction film (Levin, 1971). The documentary supposedly uses conventions of objectivity, respect for the material and a sense of real life. Objectivity in the documentary however, is problematic. Does the real world exist as an objective fact we can look at or is it something that is constructed by people through their intelligence, labor and imagination or is it a combination of all of these? How do we use the art to express the meaning of the real world? Williams (1980) philisophizes that as yet, we have no overarching theory which deals convincingly with all the factors that make the real world and its expression on film and their relations with each other. Along this vein, Bluem (1968) and Sandall (1974) claim that the processes of selection and arrangement which take place during perception and transmission are fundamental to both the artistic (subjective) and the journalistic (objective) communication of the documentaty.

Historically, the documentary has drawn much from the working procedures and validation techniques of anthropology. Indeed the documentary is replete with ideological and cultural codes. When a film maker from one culture makes a film on another culture, there is bound to be poor communication and a clash of codes (Gabriel, 1982). Several researchers (Eco, 1977; Sontag, 1982; McDougall, 1974; Mead, 1974) have docummented the difficulties outsiders encounter when they try to capture on film cultural expressions.

The history of the documentary in theory and practice, is interpretative and socially oriented. The Griersonian documentary which used direct address was overwhelmingly didactic and presumptuously authoritative (Lovell and Hillier, 1974). Another style, the documentary which used indirect address rejected the viewer supossedly capturing reality. However, this transparency was rejected as an effect produced in and upon a system of signs and codes where signs were used as the equivalent of commentaries (Nichols, 1978; Harpole, 1980; Hanson, 1977).

1980; Hanson, 1977). Subsequent documentaries which incorporated direct address into footage by using interviews were not much different; the voice of the text took the form of characters directly speaking to the audience. Interview-footage documentaries were really not very different from the authoritative direct address documentaries; interviews were used to support footage with out the footage itself being questioned. Nichols (1983) proposes a major documentary style- the self-reflexive documentary as one which possesses a textual system that asserts its own voice in contrast to the voices it observes and recruits. Direct and indirect address are mixed using observation and exposition to arrive at a dual level of reference, that of evidence and argument. Bellman and Jules-Rossette (1977) did a study along a similar vein, they claim that they are just beginning to discover the scope and importance of perspectival variations and the influence of the immediate social context upon the structuring accounts.

The documentary is socially oriented and aimed at social and political change. Rhetorical communication aims at persuasion and if the documentary is accepted to be a form of rhetorical communication, then it can be scrutinized rhetorically. Along this this line of reasoning, Winters (1963) analyzed a documentary, THE RIVER using Burke,s (1951) rhetorical format. He attempted to find out whether the communicators of THE RIVER achieved their objectives by analyzing their purposes, the setting, agents and strategies. Winters' analysis of the strategies used in THE RIVER focused on the content; he concluded that the communicators of THE RIVER used familiar names , contrast and problem solution as techniques of persuasion.

One way of determining the effectiveness of the strategies used to attain objectives is by subjecting the text to a structural analysis. The assumption is that meaning is a function not only of content but also of form. Images don't speak for themselves, the role of technique, form and style highlight an instance of construction (Nichols, 1983). In the text of the documentary, one can trace out a scheme of reference which presides over the formation of the message (Bettetini, 1973). Therefore, a study of the structure of the documentary yields insights into the manner in which the maker interprets the objects of the documentary which in turn can be related to the attainment or non-attainment of stated objectives.

Procedure

The purpose of this study was to find out if the communicators of ACROSS CULTURES attained their objectives and to find out how ACROSS CULTURES was structured to attain stated objectives. ACROSS CULTURES is a videotape series on world cultures designed to compliment sixth and seventh grade social studies textbooks. It is presented in a documentary format. The series is composed of thirteen 15-minute programs about three widely divergent cultures in three continents: Osakans in urban Osaka, Japan; the isolated Tarahumara in the Sierra Madre mountains of Mexico; and the Baoule river people in the village of Yrakrou near the capital city of Abidjan, Ivory Coast. The theme of the series is that of maintaining peace in the world by respecting cultural differences. The first three programs introduce the three cultural groups, the next seven programs describe the institutions within these three cultures and the final three programs describe their linkages with the world.

Two methods of analysis were used: a rhetorical analysis of the documentary and another, a semiotic analysis of the text. Rhetorical analysis was done using a modified version of Burke's (1951) rhetorical format. It attempted to answer the questions: what was done, when and where it was done, why it was done and who did it. The semiotic analysis of the text examined three structural devices namely: time, edits and forms of address which included narration and focal distance of the camera.

Time was defined as the total and average amount of time devoted to each culture within each program and across Programs 4 to 13. The first three programs were excluded because these were introductory programs portraying exclusively one culture in each program.

Two forms of address were analyzed. These were narration and focal distance of the camera. These were considered forms of address because they implied a position for viewing. For this analysis, three programs were systematically chosen from Programs 4-13 to constitute the sample. The sample programs were Programs 5 (The Environment), 9 (Sports, Society and Self) and 13 (Choices for the Future).

To quantify narration, the following steps were taken: 1) Shots portraying each culture were identified and counted. A shot was defined as constituting visual images between edits, the uninterrupted flow of images that the camera shot at one point in time. 2) Narration in these shots were classified as synchronized (on-camera) or non-synchronized (voice-over). 3) The frequency of on-camera and voice-over narration in all shots for each culture were determined.

Analysis of focal distance was done by 1) Defining the ranges of the distance of the object to the camera using Becker's (1983) definition.

Long shot (LS) - full shot of an entire area
Medium long shot (MLS) - shot of entire body, long distance
Medium shot (MS) - shot of one or more persons, waist up
Medium close-up (MCU) - shot of a person, shoulders up
Close-up (CU) - Shot showing detail

2)Determining the frequencies of each of the range of focal distance in all shots devoted to each culture in the sample programs.These frequencies were used to describe treatment of the three cultures.

The third structural device that was examined was edits. Edits were classified as either cuts or fades. A cut was defined as a switch from an image to another (Monaco,1981, p. 427). A fade was defined as the gradual dissappearance of the image onscreen and the gradual appearance of another. The frequencies with which fades or cuts were used for each culture in the sample programs were determined. These frequencies were compared and used to describe the structure of ACROSS CULTURES.

Findings

The Rhetorical Analysis

A series of national studies identified issues in social studies education which need to be addressed in Wisconsin in the 1980's. On this basis, the WETN conducted a survey. Among other things, this survey identified the need for an in-school television resource series for sixth and seventh grade social studies. WETN in consultation with DPI formed a committee to specify goals and content for the series. The committee was composed of six members who possessed theoritical and pedagogical expertise.

ACROSS CULTURES has two major objectives: 1) to help students understand the concept of culture, and 2) to encourage students to become familiar with and appreciate the broad range of cultures in the globally shared culture (WETN, 1983, p. 106).

ACROSS CULTURES was produced by John Robbins of Positive Image Productions (PIP) and Peter Coombes of the Academy of Research, Instruction and Educational Systems (ARIES). John Robbins is an expert with extensive local and international documentary making experience. The producers went on a reconnaisance trip using the content outline made by the content committee as a guide. This content outline which was subsequently used as the guide for on-location taping was revised on the basis of reconnaisance results. It should be pointed out though, that final decision on the revisions were made by only two of the content committee members, in a sense reflecting their own synthesis.

ACROSS CULTURES was produced at the cost of $367,000. WETN provided $150,000. Various agencies across the United States and Canada provided $179,180. AIT provided the rest through sales of the series to state and provincial agencies (DeRose, 1983).

Planning and production of ACROSS CULTURES took place between 1981 and 1983. The series which is available only on videotape, began broadcasting in January 1984.

The Structural Analysis

The analysis of the text indicates a favorable portrayal of the Japanese. Their time on screen is longest when compared to the Tarahumara and the Baoule. (See Table 1). Within the time they are portrayed, positive aspects of their culture are emphasized. Camerawork is similarly used, close-ups portray Japanese flexibility in adopting western technology (especially in Program 13-"Future Choices") . Among the Tarahumara, close-ups are used to emphasize their dirty environment (Program 5 "The Environment") and their gambling habits in the only thing they excel in- running (Program 9- "Sports, Society and Liesure"). The Baoule are treated somewhat impersonally, they are shown at a distance, mostly with medium long and long shots (Table 2). Throughout the series, narration is presumptuously authoritative. The narrator appears in sync in the beginning shots of the segments for each culture to present the thesis of his exposition. Supporting evidences are mounted in subsequent voice-over narration, this narration sets in place bits of argumentation that the image track illustrates with redundancy. (Table 3).

Data in Table 4 shows that the shots portraying the Baoule and Tarahumara were joined mostly with cuts. Fades were used mostly as a transition device, a segue from one segment to another. This was not the case with the Japanese. There were almost as many fades as there were cuts between shots. This could reflect careful editing but it can also reflect positive treatment where the negative aspects are shown in rapid cuts. For example the scenes on the tragedies like earthquakes and fire were shown in less than five seconds as if to diminish its importance/significance.

Conclusions

ACROSS CULTURES conveys the concepts of culture and cultural interdependence. It familiarizes the students

Table 1 Time (in seconds) devoted to each Culture in Programs 4-13 of the "Across Cultures" Videotape Series

Program Number	Introduction	CULTURE			Credits	Total Time
		Japanese	Tarahumara (Mexico)	Baoule (Ivory Coast)		
4 (Providing Family Needs)	51	267	203	282	46	849+51*= 900 (15 mins)
5 (Environment)	51	229	380	194	46	900 (15 mins)
6 (Religion)	51	318	219	266	46	900 (15 mins)
7 (Passing on Traditions)	51	353	204	238	54	900 (15 mins)
8 (Education)	51	312	164	319	54	900 (15 mins)
9 (Sports, Society and Self)	51	274	341	170	54	900 (15 mins)
10 (Communication)	51	426	175	194	54	900 (15 mins)
11 (Cultural Exchange)	51	407	239	149	54	900 (15 mins)
12 (Cultural Change)	51	380	295	120	54	900 (15 mins)
13 (Choices for the future)	51	342	224	176	54	847+53*⇒ 900 (15 mins)
TOTAL		3300	2444	2108		
AVERAGE		330	244.4	210.8		

*non-specific to a culture

Table 2 Frequency of use of focal distance range in all shots of segments by culture, Programs Five, Nine and Thirteen

	CULTURE														
	Japanese					Tarahumara					Baoule				
	LS	MLS	MS	MCU	CU	LS	MLS	MS	MCU	CU	LS	MLS	MS	MCU	CU
Program 5 (Environment)	15	-	2	2	9	8	-	5	2	10	6	2	1	1	-
Program 9 (Sports, Society and Self)	13	2	3	-	-	17	3	10	2	13	7	2	6	3	5
Program 13 (Choices for the Future)	8	-	11	2	16	1	21	11	-	3	1	21	11	-	4
TOTAL	35	2	16	4	25	25	25	26	4	26	13	25	18	4	9

Table 3. Frequency of narration in shots by culture, Programs 5, 9 and 13

	CULTURE					
	Japanese		Tarahumara		Baoule	
Program	On-camera	Voice over	On-camera	Voice-over	On-camera	Voice-over
5 (Environment)	3	23	3	22	3	7
9(Sports, Society & Self)	-	18	2	43	-	18
13(Choices for the Future)	2	34	-	21	-	21
TOTAL	5	77	-	86	3	56

Table 4. Frequency of edits, all shots by culture, Programs 5, 9 and 13

	CULTURE					
	Japanese		Tarahumara		Baoule	
Program	Cut	Fade	Cut	Fade	Cut	Fade
5(Environment)	8	18	20	5	6	4
9 (Sports, Society and Self)	12	6	43	2	18	5
13(Choices for the Future)	28	8	15	6	13	8
TOTAL	48	32	75	13	37	17

with the three cultures which are presented as examples of the wide range of diverse cultures in the world. The manner of portrayal encourages the students to appreciate the Japanese culture, one which is similar, at least technologically, to the West. However, the portrayal of the Tarahumara (Mexican) and the Baoule (Ivorian) works against the development of appreciation for these cultures. The series is structured so that the audience identifies with and appreciate the Japanese but it is prescriptive of the Tarahumara presenting western technology as solutions to their problems. The series implies urbanization and foreign trade as inevitable/ desirable future choices for the Baoule. A videotape which aims to help students develop appreciation does not offer prescriptions.

ACROSS CULTURES is replete with ideological and cultural codes. It illustrates the problems of realistically portraying cultures from the outside. ACROSS CULTURES does not present the "truth" from "facts" because the objective and neutral videoist does not exist. The implications of this study are: 1) There is a need for closer cooperation between those who decide the content of instructional materials such as a documentary, and the producer because the actualization on tape of the intentions of the content committee is mediated by the producer. The gaps between intended and actual portrayal of the three cultures in ACROSS CULTURES were inevitable given the instructional design used. 2) It is highly desirable to incorporate the participants' perceptions of their activities which are portrayed on tape even if they have to be trained, 3) Given the constraints of the documentary process, it is imperative that the viewers be made aware of the conditions under which the documentary was produced so that they can make their own conclusions, and 4) A rhetorical study of the documentary can aid in the development of a "rhetoric of the documentary film or videotape" in much the same way as Aristotle's Rhetoric has the scholar of oral discourse. Such rhetoric which should include analysis of both content and form could reveal the manner in which the documentary can be designed to achieve stated objectives

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Using Microcomputers for Drill and Practice: Issues and Implications[1]

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Use of the microcomputer as a means to provide practice drills to learners is regarded by some as not being a creative use of the computer. Computer programs are often criticized for containing too much drill and practice. Apparently, some people feel that it is a shame to use a marvelous device like the computer for "mere" drill and practice, when it could be used for seemingly more creative activities.

In her recently published book, Helm (1984) pointed out the irony involved in criticism by teachers of computer-based drill and practice. It would seem that teachers would welcome a tool to provide individualized practice to students beyond what they themselves are able to provide. Teachers do not typically enjoy conducting drill and practice routines and using the computer to provide this essential activity could conceivable free up teacher time to spend in developing student's higher order cognitive skills.

Part of the reason for the negative view of computer-based drill and practice is probably due to the desire of teachers to pursue seemingly more exciting intellectual activities, therefore, any drill and practice program, no matter how well designed or sophisticated is viewed as undesirable. Much of the negativism, however, is undoubtedly due to the problem of the quality of the drill and practice software currently in the schools. Many computer drill and practice programs are admittedly dry, boring, and unpleasant and often ignore some of the most basic principles derived from research in learning psychology. However, these bad examples should not cause us to underestimate potential value of computer-based drill and practice. Practice does not have to be dry and unpleasant. Many kinds of arrangements can be made to make drill and practice an interesting activity.

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[1] Presented at the annual meeting of the Association for Educational Communications and Technology, January 1985, Anaheim, CA.

This paper describes some of the issues and implications related to using the microcomputer as a means to provide practice activities. Also described are two drill and practice programs which exemplify a higher quality and sophistication of computer-based practice strategies. Finally, the paper describes a program of research being conducted at Florida State University to identify effective and efficient computer-based drill and practice instructional strategies.

Automaticity of Subskills

Recent research in modern cognitive learning is suggesting that drill and practice may be more important than many people realize. The research that suggests this is related to the area of automaticity of subskills. Automaticity refers to the state at which a skill ceases to consume much of the attentional capacity of the brain. Usually, an automatized skill can be performed simultaneously with other tasks without interfering with the performance of those tasks. Examples of skills which have become automatic to some people are skills such as typing, discriminating numbers from letters, or decoding common words.

Research is suggesting that in order for learners to perform complex skills such as reading, computer programming, or mathematical problem solving, many of the subprocesses involved have to have become automatic to the learner. The implications of this research are that certain basic procedures which later become subprocedures to higher order skills ought to be not simply mastered, but brought to a state of automaticity.

As far as we know at the present time, the only way a skill becomes automatic is through an extensive amount of practice, usually extending over a long period of time. Because it is difficult for teachers or trainer to provide sufficient practice to assure that all students automatize important subskills, many prominent researchers are looking to the computer as a means to more efficiently provide the type and amount of practice necessary to produce automaticity (e.g. Gagne, 1982; Lesgold, 1983). However, these researcher have pointed out that computer drills which will effectively help learners automatize skills will probably need to be more sophisticated and better designed that the typical drill and practice programs currently available for microcomputers.

The concept of automaticity also implies that in addition to accuracy of performance, speed, and the ability to perform the skill without interfering with a secondary task are important criteria for determining mastery (Resnick & Ford, 1981, chap. 2). Also implied is the idea that performance could profitably be evaluated and remediated in terms of "bugs" in subskill performance. Brown and Burton (1978) have demonstrated that all errors computed by students are not random errors, but many times are an indication of a bug or a bug combination in one of more of the subprocesses.

In the context of using the computer as a tool for helping students automatize skills several issues arise:

1. Which skills should be automatized?

2. What needs to be done to make certain that a skill has attained the status of automaticity?
3. When should practice be given and how much practice should be given?
4. What kind of data should be collected on individual student practice performance and how should that data be used?

Which Skills Should be Automatized?

Skills which need to be automatized are those which have to be carried out by the student simultaneously with other skills or, as part of a higher level, more complex skill. We know from the work of such researchers as Schneider & Schiffrin (1977), Lesgold & Resnick (1982), and Beck, Perfetti, & McKeown (1982) that many of the basic component skills of reading and math need to be automatized. It is obvious that efficient computer programmers, typists and musicians have all automatized many of the subprocesses which constitute their respective skills. At this point we do not have any way of determining whether a skill needs to become automatic other than looking at a person who performs the higher level skill and trying to determine which subskills that person performs automatically. Task analysis (breaking down a skill into its component parts) should be used as a tool for helping us determine the subskills involved in performance of a higher-order skill.

What Needs to Be Done to Make Certain That a Skill Has Attained the Status of Automaticity?

Automaticity is a fairly new concept and ways to measure it are still forthcoming. At the present time we might establish the policy of including speed and the ability to perform the skill simultaneously with some other skill as criteria for mastery.

In order to accomplish this, practice drills could be devised to include three stages. The first stage would concentrate on helping the student learn to perform the skill accurately. In the second stage speeded practice would be introduced until performance is both fast and accurate. In the third stage, a competing task or game would be introduced which the student would have to attend to while performing the original task. What we are working for is performance which is not only fast and accurate, but fast, accurate, and automatic.

When Should Practice be Given and How Much is Needed?

There is much evidence in the literature to suggest that short, spaced periods of practice give better results than long concentrated practice sessions (see Anderson, 1980). This spacing effect has repeatedly been shown with many types of material. If the computer is to be used as a tool for developing automaticity it will have to be integrated into the curriculum in such a way that students can space practice of a skill over a period of time in a systematic manner. Some computer drills are designed to be completed by the learner in one sitting. If the learner stops the drill and resumes it later, the learner is required to practice on the same items in the same sequence as before, which is not a good practice strategy.

In order to produce automaticity, what is needed are computer programs which include the capability of allowing the learner to stop and resume practice sessions without starting at the lowest difficulty level of the skill or with the same items as before. In some cases, this can be done by dividing the content into difficulty levels and allowing the learner to specify the appropriate difficulty level for each practice session. In other cases, this must be done by having the computer keep a record of each individual learner's performance on the drill. This requires that the learner sign on to the drill by name and date so that at the beginning of each new practice session, the computer can retrieve the individual record for that learner.

Because automaticity requires that a skill be overlearned and used over a long period of time, computer drills should be designed to be "practice and review" drills rather than simply practice drills. Once an item or piece of material has been learned, a mechanism should be provided to reintroduce that item or material systematically for review. This can be done by setting up a series of review stages allowing mastered items to be reviewed at different stages, say after a day, then again after a week, then after a month.

Another way to approach this might be to provide "increasing-ratio review" where the amount of review material increases and the amount of new material decreases as more material is covered. When the student first begins the drill, all the items are new items. As the student masters items, these become review items and are reintroduced systematically into the drill. Eventually most of the items the student will be working with will be review items.

As you can see, using the microcomputer in this way would require an integration into the classroom or training curriculum that is different from the typical adjunct use of the microcomputer in the classroom.

What Kind of Data Should be Collected on Individual Student Performance and How Should That Data be Used?

Computer drills could be categorized as being of two types: intelligent and non-intelligent. Intelligent drills would be those which continuously collect data on student performance during the drill and use that data to modify presentation of the drill on an item-by-item basis. Non-intelligent drills would be those which do not collect student performance data and which present the same items to each learner in the same sequence each time.

Using a learner's response history to make instructional decisions and alter the remaining instructional sequence requires the continuous collection of student performance data. It also requires the use of mathematical models to specify optimal sequencing schemes. In designing an intelligent computer drill the question arises of what data to collect and how to use that data to alter the sequence of instruction. Atkinson (1974) has shown how the principles derived from what is referred to in the literature of mathematics and engineering as *optimal control theory*, or simple *control theory* can be used to optimize the instructional sequence for a particular learner. The type of data which typically has to be collected includes what items have received correct responses, how many intervening items have been seen, and, for review purposes, how long of a time period has elapsed since an item was seen. The two computer drill strategies described later in this paper demonstrate different approaches to utilizing student performance data to modify the instructional presentation.

Two Good Drill and Practice Strategies

The Corrective Feedback Paradigm

The Corrective Feedback Paradigm (CFP) is a drill and practice strategy which could be used to present drills on paired-associate tasks such as medical terminology, chemicals and their abbreviations, English and foreign language vocabulary, etc. As opposed to the type of drill which could be done by hand with flashcards, the CFP adds several features only available in a computerized drill. Each of these are discussed briefly below.

Specialized Feedback. In learning paired-associated items, two types of errors are possible: 1) out-of-list errors (giving a response which is not an answer to another item in the list), 2) discrimination errors (giving a response which is an answer to another item in the drill list). In the CFP, the type of feedback provided to the learner is a function of the type of mistake made. If the learner makes an out-of-list error. the correct answer is provided; for a discrimination error, the feedback tells the learner what stimulus the student responded to as well as the answer to the stimulus that was actually provided.

Discrimination Training. After committing a discrimination error, the student is given a discrimination training sequence. This involves presenting the item missed and the item with which it was confused. The student must be able to respond correctly to both stimuli before returning to the drill.

Spaced Review. After the student makes a mistake, the missed item reappears according to a spaced review schedule determined by the designer who may specify up to three review positions. For example, a missed item might appear after 2 intervening items, then again after 6 more items, then a third time after 10 more items. At any stage during the review cycle an incorrect response on a review item reinitializes the review sequence for that item.

Retirement Criterion. Items are retained in the drill until the student responds correctly to an item a specified number of times in a row. This number can be set by the designer of the drill. As items are retired from the drill the number of items the student is working with decreases until all items have been retired.

Because the CFP is a drill template designed to accommodate various content, all of the features of the CFP--feedback messages, spacing of the review, and retirement criterion can be set and manipulated by the designer. The CFP is available on the PLATO instructional computing system and has been used to construct drills in various content areas. Comparisons of the CFP with other drill paradigms show that the CFP is a more effective means of providing training in these types of skills than what could be done by hand without using a computer (Seigal & Misselt, 1984).

The Progressive State Paradigm

The Progressive State Paradigm is a sophisticated drill strategy which uses a student's response history to alter the remaining instruction in order to optimize the learning process for that student. This is done by presenting items in six exercise formats. Optimization of the drill involves deciding which items to present, which exercise formats to present them in, and when to schedule review. This requires a complete response history for each student and use of this history to make trial-by-trial decisions regarding which items to present next.

Figure 1 presents a flowchart (adapted from Atkinson, 1974) showing the structure of the drill and the various exercise formats. When a student begins a practice session, any items left in his or her working pool from the last session are transferred from the disk to the current working pool. If the working pool is not full, then additional items are selected from the review pool if there are any items which have a review date less than or equal to today's date; otherwise additional items are selected from the new item pool. The working pool is then shuffled and the first item is selected from the working pool and its state identified. The item selected may be shown to the learner in any one of six states. If the item has just entered the working pool for the first time, it will be presented as a pretest item (state 1). If the learner responds correctly to the item, it will be deleted from the system. Otherwise, its state will be updated to state 2. The value of the item counter (N) is then incremented, and the second item from the working pool is selected. This item is presented in accordance with its specified state. Note that after an item is presented in state 3, it is removed from the working pool and transferred to the review pool. after all items in the working pool have been presented once (N > 7), the working pool is replenished and shuffled, and the item counter (N) is set back to 1. This process is repeated until the student terminates the practice session.

When an item is presented in the Rehearsal state (state 2), the stimulus and corresponding response are presented to the learner simultaneously to allow the learner to associate them together. The learner is then asked to merely enter a copy of the correct response. In the Drill state (state 3), only the stimulus is presented, and the learner is asked to enter the correct response. If the item has been answered correctly a sufficient number of times to pass the specified criterion, then it is transferred to the review pool. The review date is set for the appropriate date (generally the next day).

During any of the Review states (states, 4, 5, and 6), only the stimulus is presented, and the learner is asked to enter the correct response. This is identical to how the item is presented in the Drill state. When an item has been answered correctly to the criterion level set for the specific Review state, it is removed from the working pool and transferred back to the Review pool with a new review date.

All of the criterion settings which determine when to move an item from one state to the next as well as the other features of the Progressive State Paradigm (number of items in working pool, spacing between reviews, etc.) can be manipulated by the designer to fit the nature of the application and ability level of the students.

Current Research at Florida State University

At Florida State University we are currently engaged in three programs of research which relate to the design of computer-based drill and practice instructional strategies. The first program of research related to this area seeks to identify guidelines for designing practice drills by drawing from the basic sciences of behavioral and cognitive psychology. Currently, we are attempting to integrate the findings of this literature review into a model or aid for designing computer-based practice strategies.

The second research program attempts to empirically verify the prescriptions and recommendations for designing practice derived from the work described above. In this investigation, microcomputer technology is used to deliver different practice strategies in order to test the relative effects of these strategies on learning. This program also involves the evaluation of commercially available drill and practice programs for microcomputers in order to categorize them as to effectiveness and to evaluate the degree to which they incorporate the recommendations derived from the literature.

In a third project, the ability to use the computer to develop subskill automaticity is being explored. This project deals with development of skills necessary to efficiently solve mathematical word problems. Theorists have proposed that in order to solve math word problems learners must develop skills in several related subskill areas, the most important of which are keyword recognition, problem type recognition, goal identification, diagramming, basic computation, and answer estimation. As part of this project, computer-based training involving sophisticated drill and practice strategies is being developed to produce automaticity in these skills. This program is serving to provide a unique laboratory for investigating the role and effectiveness of various instructional strategy parameters in producing automaticity. It is hoped that these investigations will provide validated guidelines for the development of efficient and effective computer-based drill and practice instructional programs.

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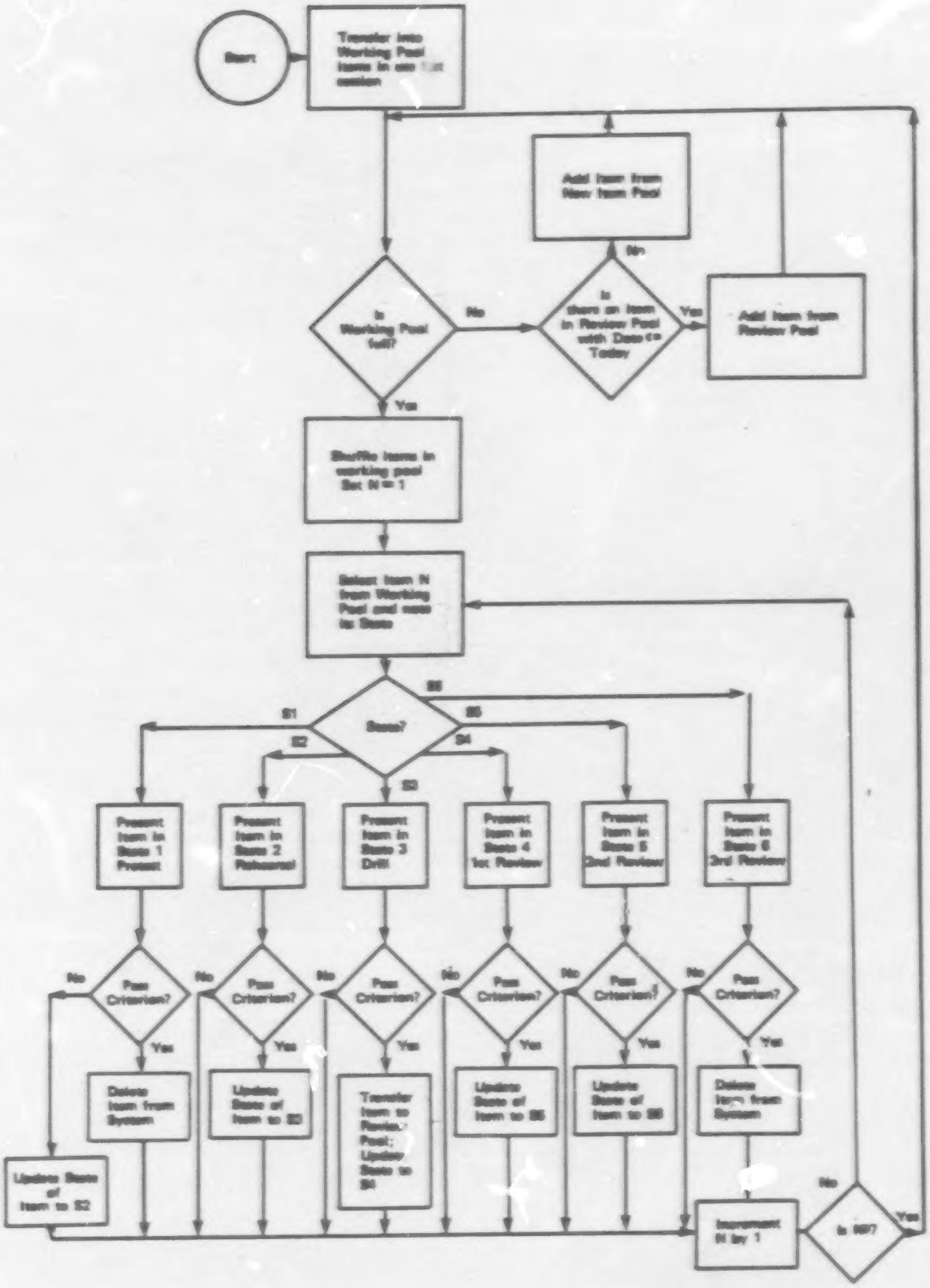
Start
Transfer into Working Pool Items in one [illegible] session
Add Item from New Item Pool
Is Working Pool full?
No
Yes
Is there an Item in Review Pool with Date <= Today
No
Yes
Add Item from Review Pool
Shuffle Items in working pool Set N = 1
Select Item N from Working Pool and note its State
State?
S1
S2
S3
S4
S5
S6
Present Item in State 1 Present
Present Item in State 2 Rehearsal
Present Item in State 3 Drill
Present Item in State 4 1st Review
Present Item in State 5 2nd Review
Present Item in State 6 3rd Review
Pass Criterion?
No
Yes
Delete Item from System
Update State of Item to S2
Update State of Item to S3
Transfer Item to Review Pool; Update State to S4
Update State of Item to S5
Update State of Item to S6
Delete Item from System
Increment N by 1
Is N>P?
No
Yes

Flowchart showing the structure of a progressive state paradigm (adapted from Atkinson, 1974).

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THE RELATIONSHIP BETWEEN
TEACHER BURNOUT
AND
MEDIA UTILIZATION

Paper for presentation to the
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Presented by

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The Relationship Between
Teacher Burnout and Media Utilization

The purpose of this study was to assess the relationship between teacher burnout and the use of various media in teaching. Data were collected from schoolteachers in the Fort Worth, Texas public school system, and analyzed, in an attempt to answer the question: Do teachers who are low in burnout use certain media materials more frequently than do teachers who are on the other end of the burnout spectrum?

In the past decade, researchers have reported that workers in the human service field have been susceptible to, what has been termed, the "burnout syndrome" (Cherniss, 1980b). According to Maslach and Jackson (1981), persons in the "helping professions," such as teaching, frequently exhibit negative attitudes towards their clients, as well as tend to evaluate their own work negatively. In addition, many workers report that they are emotionally and physically exhausted, due to an inability to cope positively with high job-related stress (Pines & Maslach, 1978). Burnout, in general, can be defined as "a syndrome of inappropriate attitudes towards clients and towards self, often associated with uncomfortable physical and emotional symptoms ranging from exhaustion and insomnia to migraine and ulcer," as well as with "deterioration of performance" (Kahn, 1978, p. 61).

"Teacher burnout" can be defined, more specifically, as a negative pattern of responding to stressful teaching events, to students, and to teaching as a career, as well as a perception that there is a lack of administrative support. The inability to cope with teaching problems and with uncooperative students in a constructive manner (Pratt, 1978), and the failure of supervisory personnel to provide positive leadership (Cook, 1979) have been cited as factors that are associated with low teacher morale and teacher burnout.

Teaching, at all levels of the educational system, can be a stressful experience. Researchers have stated that a certain proportion of teachers become dissatisfied with their jobs, and eventually burn out (Bloch, 1977; Truch, 1980; Weiskopf, 1980). A survey, by the National Education Association, found that 35% of public schoolteachers were dissatisfied with their current teaching jobs, and (of that group), almost 9% were highly dissatisfied ("NEA Survey," 1980). More than two-fifths (41%) of the teachers polled in the 1983 NEA Survey expressed doubts that they would become teachers again, if they had the chance to start over ("Given a Second Chance," 1983). Certainly, job dissatisfaction and burnout have contributed to high rates of teacher absenteeism and turnover, as well as to low school morale (Cunningham, 1982). Burnout is contagious. When dissatisfied and depressed teachers are present in a school, others can be infected with the "disease," in which negativism, lethargy and despair are symptoms. In a short period of time, the entire organization can become a dispirited place (Freudenberger, 1977).

While some school teachers cope well with job-related stress, others do not (for a variety of reasons, both personal and organizational). It has been suggested that teachers who have had an adequate professional preparation, and who have been encouraged and supported in their efforts to do a good job are less prone to burn out (Spaniol & Caputo, 1980). Therefore, teachers who report that their efforts are supported by their administrators, who have had a good media-utilization component in their preservice and/or inservice training programs, and who are not enervated by the burnout syndrome should be more likely to use media in their teaching.

Of course, there are many reasons (technological, administrative/ institutional, economic, and personal) why teachers do not employ media (Gillet, 1973; Rose, 1982). Gillet (1973) suggested that weariness (associated with burnout) and laziness were factors in the failure to utilize media. Rose (1982) believed that educators resist using instructional technologies due, in part, to the lack of motivation "to adapt course content to the technology, to manipulate the equipment, and/or to prepare software" (p. 12). One aspect of burnout is the feeling that the job and the clients are not worth the effort. An extremely burned-out individual is more likely to cope with job-related stress with expressions of anger, sadness and/or depression, not by trying harder. Burnout is characterized by a lack of enthusiasm and excitement by workers (Cherniss, 1980a). The regular use of many (though probably not all) media requires some motivation and exertion of effort, as well as positive administrative support.

This study investigated whether teachers who scored low on the subscales of an instrument designed to measure teacher burnout used media materials in their classrooms more frequently than did teachers who had higher scores on the subscales. The subscales measured teachers' perceptions about the degree of administrative support received, their career satisfaction, their ability to cope with the stresses related to teaching, and their attitudes towards students -- all major factors underlying teacher burnout (Seidman & Zager, 1984).

Method

Sample

A total of 545 public schoolteachers participated in the study in early April, 1984. All were members of the Fort Worth Classroom Teachers' Association, which distributed 1490 data packets to teachers in all schools with at least 24 members. The return rate was thus 37%. It also should be noted that 79% of all Fort Worth public schoolteachers belong to this teachers' association. In the various statistical analyses, the number of valid cases ranged from 470 to 483, due to the exclusion of 32 special education teachers, and the elimination of those participants who submitted forms with multiple responses or missing data.

These regular classroom teachers were predominantly female (78.9%) and married (68.1%). The median age of the sample was 42, and the median years of teaching experience was 15. Slightly more than half (51.2%) of the teachers indicated that the bachelor's degree was the highest they held; 48.4% reported that the master's was the highest degree held; only 0.4% had earned a doctor's degree. Finally, 40.9% of the Fort Worth sample were elementary schoolteachers, 29.1% taught in middle or junior high schools, and 30.1% worked at the high school level. The characteristics of schoolteachers in this sample were similar to those of teachers in recent NEA surveys ("Given a Second Chance," 1983; "NEA Survey," 1980; Turner, 1983), except there was a higher proportion of females in the present study. Similar percentages of both the Fort Worth sample (73.3%) and those in the national, NEA survey (74%) indicated that they were relatively satisfied with their teaching careers ("Given a Second Chance," 1983).

Instruments

The Teacher Burnout Scale (Zager & Seidman, 1983), a demographic questionnaire, and a media utilization inventory were employed in this study. The Teacher Burnout Scale is a 21-item, Likert-type scale with six response options ("strongly," "moderately," and "slightly" agree or disagree). It has four subscales: (a) perceived administrative support, (b) career satisfaction, (c) coping with job-related stress, and (d) attitudes toward students. The reliability and validity of the subscales is high, according to Seidman and Zager (1984). The Teacher Burnout Scale (broken down into subscales) is presented in Table 1. The media utilization inventory also used the Likert-scale format to measure the frequency that materials for 11 different media (e.g., filmstrips, motion pictures, and computer programs) were used in one's teaching. Seven response categories were offered to participants: "Never" (0 points), "A few times a year or less" (1), "Once a month or less" (2), "A few times a month" (3), "Once a week" (4), "A few times a week" (5), and "Every day" (6).

Data Analysis

The scores on the subscales of the Teacher Burnout Scale were summed. Then these subscale scores were correlated with the frequency of utilization of materials for each of the media (i.e., Pearson product-moment correlation coefficients were calculated). Additionally, teachers with low scores on the four subscales (i.e., equal to or below an average of 2.0 per item) and those with high scores (i.e., equal to or above an average of 5.0 per item) were placed in "low burnout" and "high burnout" groups, respectively, and their utilization of media materials was compared, using t-tests, on the four dimensions of teacher burnout.

Results

As shown in Tables 2 through 5, a relationship exists between the frequency that certain media materials are utilized and teachers' attitudes about their careers and their students, as well as how well they cope with teaching-related stress and how they view their administrators. The negative Pearson product-moment correlation coefficients indicate that, in general, teachers who employed various media materials (with motion pictures, overhead transparencies, and computer programs being notable exceptions) are somewhat more satisfied with their teaching careers, cope better with job-related stress, and have a more positive attitude toward students and administrators. Statistically significant correlation coefficients, for the total sample, ranged from -.16 to -.08.

The correlational analysis of the combined data from all three types of school (i.e., elementary, middle/junior high, and high school levels) thus revealed the existence of a relationship between the utilization of certain media materials and the dimensions of teacher burnout. However, separate correlational analyses (also reported in Tables 2 through 5) showed that this relationship was strongest at the elementary level (at which 17 of 44 Pearson product-moment correlation coefficients were significant at the .05 level) and weakest at the high school level (3 of 44 were significant). Appropriately, the correlational analysis for the middle/junior high school teachers (10 significant coefficients out of 44) placed them in between the other two groups. One should keep in mind, in interpreting these results, that the elementary group was larger than the other two groups, thus making it easier for the correlation coefficients for elementary teachers to attain statistical significance.

In particular, elementary schoolteachers who used filmstrips more frequently had more positive attitudes toward students (r = -.27), felt more satisfied about their careers (r = -.18), coped better with job-related stress (r = -.16), and believed that they received more support from administrators (r = -.16). Use of video tapes, at the elementary level, also was significantly correlated with these four factors of teacher burnout (r = -.21, -.28, -.14, and -.15, respectively). In addition, the frequency that models and 35mm slides were utilized by elementary teachers was significantly correlated to three of four burnout factors, and the use of audio tapes to two of the four dimensions.

At the middle/junior high school level, teachers who employed games and simulations felt more positively about students (r = -.21) and about their careers (r = -.19) than did colleagues who used these materials less often. Those who utilized phonograph records and models more frequently coped better with teaching-related stress (r = -.16 and -.17, respectively) and had greater career satisfaction (r = -.14 and -.17).

High school teachers who used video tapes in their classrooms coped better with on-the-job stress (r = -.17) and had a more positive attitude toward students (r = -.14) than did teachers who used video tapes less frequently. On the other hand, there was a tendency for high school teachers who were more dissatisfied with their careers to utilize computer programs more often than did their more satisfied colleagues (r = .14).

Finally, means were calculated for the frequency of utilization of each of the 11 different media by "low" and "high burnout" teachers on each of the four subscales of the Teacher Burnout Scale. As previously mentioned, only teachers who (on the average) were in strong or moderate agreement with "low burnout" items, on the subscales (after recoding), were included in this analysis. The "low burnout" group comprised 26% of the total sample for Subscale 1, 27% for Subscale 2, 24% for Subscale 3, and 18% for Subscale 4. Teachers who were in strong or moderate disagreement with "high burnout" items made up 6%, 14%, 6%, and 7% of the sample for Subscales 1 through 4, respectively.

T-tests revealed (as reported in Tables 6 through 9) that 14 (of 44 possible) pairs of means were reliably different. As Table 6 indicates, teachers who believed that they received a great deal of support and encouragement from their administrators used filmstrips, games and simulations, overhead transparencies, and pictures from books and magazines more frequently than did teachers who perceived that administrators failed to support and praise their efforts ($\underline{p} < .05$). Those who viewed their teaching careers positively employed games and simulations, video tapes, models ($\underline{p} < .01$), filmstrips, and audio tapes ($\underline{p} < .05$) more often than did teachers who were dissatisfied with their careers (as reported in Table 7). Teachers who coped positively with job-related stress made more frequent use of models ($\underline{p} < .01$) than did those who coped negatively (see Table 8). Finally, as Table 9 shows, teachers who had a positive attitude about students utilized filmstrips ($\underline{p} < .01$), games and simulations, book and magazine pictures, models, and video tapes ($\underline{p} < .05$) more frequently than did the teachers who held negative sentiments.

Discussion

The results of this study should be interpreted with some caution. While the demographic and attitudinal data obtained from the Fort Worth sample would seem to indicate that it is fairly representative of the public-schoolteacher population of the United States, all the respondents were members of a teachers' association and there was a higher proportion of female teachers than would be present in a national sample. Furthermore, the 37% rate of return (although not atypical for studies such as this one) injects some further doubt about the sample. In addition, the teachers in the study were not asked about the availability of equipment and software, as well as about their training in media utilization. Data on these factors should be collected in future investigations.

Despite the above reservations, one can come to some tentative conclusions. The correlational analyses revealed that teachers on the lower end of the four burnout dimensions tended to use certain media materials more frequently than did teachers who were more burned out. This seemed to be somewhat more the case for elementary teachers than for public schoolteachers at higher educational levels. While the relationship between media utilization and teacher burnout is not a particularly strong one (in terms of the magnitude of the correlation coefficients) or present for all media materials, it is apparent that the relationship exists. The lack of an association between teacher burnout and the utilization of motion pictures, overhead transparencies, and computer programs, in general, can be explained by the probable use of such materials by teachers at all levels of career satisfaction, attitudes toward students, coping with job-related stress, and perceived administrative support. Films are often obtained by supervisors or interested teachers and shown to more-than-one class. Overhead transparencies can be made quickly and can function as software for "electronic chalkboards." Utilization of computer programs, if available at all, is as likely to be imposed on unwilling teachers as on those eager to employ this new technology. In fact, there is some evidence in this study to suggest that forcing teachers to use computers could contribute to higher burnout levels for high school instructors.

Use of other media materials, particularly video tapes, filmstrips, 35mm slides, and models, would seem to demand a more positive attitude and more energy on the part of a teacher. As Bellamy, Whitaker, and White (1978) wrote: "The majority of teachers are afraid of media equipment, are unaware of resources available, and are unwilling to expend the extra effort required to locate media resources, plan for the use of such resources in a presentation, or make arrangements for set-up and operation of necessary equipment" (p. 7). Although factors other than burnout no doubt affect media utilization to some extent, it would appear that teachers who are victims of the "burnout syndrome" generally use media materials less frequently in their classrooms.

The analysis of the media-utilization data of the "low" and "high burnout" groups (which together comprised between 25% to 41% of the sample) revealed that generally teachers with moderate to extreme burnout feelings used media materials less than did those who had the opposite beliefs. Almost every media-utilization mean for the "low burnout" groups, on all four dimensions, were higher than were the means for the "high burnout" groups, with differences for games and simulations and for filmstrips statistically significant on three of the four subscales. Pictures from books and magazines, as well as models and video tapes, also were more heavily utilized by "low burnout" teachers, as shown by statistically significant t-test results. In fact, the only two media for which no discernible differences emerged were motion pictures and computers.

The results of this study, although exploratory, indicate that teachers tend to use media materials less (or not at all) as burnout feelings increase. Does teacher burnout cause victims of this syndrome to utilize media less, or does the failure to employ media enhance such feelings? We cannot answer this question, but it seems safe to at least conjecture that the unwillingness to use media is both a symptom and a cause of burnout. Gray (1982) suggested that the employment by teachers of a variety of stimulating media programs and instructional strategies could help them "overcome burnout and face [their] old jobs with renewed interest" (p. 22). It would seem that many public schoolteachers may become negative about their students and their careers, and at some point "give up." Such emotionally and physically drained persons, who are insensitive to the needs of their students, are unlikely to use most media very often in their teaching to motivate and instruct (if they ever did).

How can we lower burnout levels and increase the frequency that various media are utilized by teachers? It is possible that a concerted effort to interest schoolteachers to use instructional media materials could help revitalize those persons who are "burning out." If there is any hope of this strategy succeeding, then it is necessary that those concerned with teacher education and professional development provide training programs and assistance in media utilization, as well as arrange for workshops, retreats, self-support groups, and other approaches that have proven to help in alleviating burnout among teachers.

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Table 1

The Teacher Burnout Scale

Subscale 1: Perceived Administrative Support

*3. I get adequate praise from my supervisors for a job well done.
8. I feel that the administrators are willing to help me with classroom problems, should they arise.
11. I believe that my efforts in the classroom are unappreciated by the administrators.
15. My supervisors give me more criticism than praise.
18. I feel that the administrators will not help me with classroom difficulties.
20. The administration blames me for classroom problems.

Subscale 2: Satisfaction with Teaching Career

1. I look forward to teaching in the future.
5. I am glad that I selected teaching as a career.
10. Teaching is more fulfilling than I had expected.
12. If I had it to do all over again, I would not become a schoolteacher.
19. I look forward to each teaching day.

Subscale 3: Coping with Job-Related Stress

2. I feel depressed because of my teaching experiences.
4. The teaching day seems to drag on and on.
7. My physical illnesses may be related to the stress in this job.
9. I find it difficult to calm down after a day of teaching.
13. I feel that I could do a much better job of teaching if only the problems confronting me were not so great.
14. The stresses in this job are more than I can bear.

Subscale 4: Attitudes Toward Students

6. The students act like a bunch of animals.
16. Most of my students are decent people.
17. Most students come to school ready to learn.
21. Students come to school with bad attitudes.

*Numbers indicate the placement of the item, when administered.

Table 2

Pearson Product-Moment Correlations Between Use of Different Media Materials and Perceived Administrative Support (Subscale 1 of Teacher Burnout Scale)

Medium	Elementary School Teachers (N = 191-192)	Middle/Junior High School Teachers (N = 138-139)	High School Teachers (N = 139-141)	Total Sample (N = 470-472)
Filmstrips	-.16*	-.14*	-.06	-.10*
35mm Slides	-.14*	-.04	-.10	-.10*
Pictures from Books and Magazines	-.08	-.01	.04	-.01
Games and Simulations	-.07	-.10	-.11	-.06
Motion Pictures	.01	-.07	.13	.03
Video Tapes	-.15*	-.14*	.05	-.07
Audio Tapes	-.15*	.01	.07	-.04
Phonograph Records	.00	-.01	.11	.04
Overhead Transparencies	-.02	-.15*	-.02	-.06
Models	-.17**	.03	-.08	-.08*
Computer Programs	.02	-.13	-.02	-.04

*$p < .05$. **$p < .01$.

Table 3

Pearson Product-Moment Correlations Between Use of Different Media Materials and Career Satisfaction (Subscale 2 of Teacher Burnout Scale)

Medium	Elementary School Teachers (N = 191-192)	Middle/Junior High School Teachers (N = 141-142)	High School Teachers (N = 141-143)	Total Sample (N = 474-476)
Filmstrips	-.18**	-.14	.00	-.13**
35mm Slides	-.17*	-.03	-.01	-.08*
Pictures from Books and Magazines	.02	-.16*	-.11	-.09*
Games and Simulations	-.08	-.19*	-.14	-.15**
Motion Pictures	-.05	.07	.09	.00
Video Tapes	-.28***	-.08	-.06	-.14**
Audio Tapes	-.10	-.13	-.03	-.10*
Phonograph Records	-.03	-.18*	.02	-.09*
Overhead Transparencies	.00	-.10	-.01	-.04
Models	-.13*	-.14*	-.12	-.14**
Computer Programs	.02	-.07	.14*	.03

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 4

Pearson Product-Moment Correlations Between Use of Different Media Materials and Coping with Job-Related Stress (Subscale 3 of Teacher Burnout Scale)

Medium	Elementary School Teachers (N = 193-194)	Middle/Junior High School Teachers (N = 134-135)	High School Teachers (N = 145-147)	Total Sample (N = 474-476)
Filmstrips	-.16*	-.12	-.06	-.11**
35mm Slides	-.08	.12	-.08	-.03
Pictures from Books and Magazines	-.06	-.02	-.07	-.05
Games and Simulations	-.10	-.09	-.12	-.09*
Motion Pictures	.02	.02	.12	.04
Video Tapes	-.14*	.00	-.17*	-.12**
Audio Tapes	-.02	-.02	-.06	-.03
Phonograph Records	.01	-.16*	.09	-.01
Overhead Transparencies	.02	-.08	-.04	-.02
Models	-.07	-.17*	-.01	-.08*
Computer Programs	-.04	-.09	-.04	-.05

*$p < .05$. **$p < .01$.

Table 5

Pearson Product-Moment Correlations Between Use of Different Media Materials and Attitudes Toward Students (Subscale 4 of Teacher Burnout Scale)

Medium	Elementary School Teachers (N = 196-197)	Middle/Junior High School Teachers (N = 140-141)	High School Teachers (N = 145-146)	Total Sample (N = 482-484)
Filmstrips	-.27***	-.10	.06	-.15**
35mm Slides	-.15*	.06	-.12	-.10*
Pictures from Books and Magazines	-.14*	-.03	-.04	-.10*
Games and Simulations	-.10	-.21**	-.09	-.14**
Motion Pictures	-.06	.00	.04	-.04
Video Tapes	-.21**	-.11	-.14*	-.16***
Audio Tapes	-.13*	-.11	-.06	-.12**
Phonograph Records	-.04	-.13	-.02	-.09*
Overhead Transparencies	-.01	-.02	.00	-.01
Models	-.17**	.02	-.02	-.09*
Computer Programs	-.03	-.11	.11	.00

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 6

Mean Media-Utilization Scores for Negative and Positive Administrative Support Groups (Subscale 1 of Teacher Burnout Scale)

Medium	Negative Administrative Support Group (N = 30)	Positive Administrative Support Group (N = 127-129)	t
Filmstrips	1.33	2.00	2.29*
35mm Slides	.50	.71	1.34
Pictures from Books and Magazines	1.93	2.82	2.26*
Games and Simulations	1.87	2.81	2.45*
Motion Pictures	1.33	1.48	.49
Video Tapes	.57	.92	1.95
Audio Tapes	1.40	1.58	.48
Phonograph Records	2.07	2.16	.21
Overhead Transparencies	2.40	3.26	2.07*
Models	1.50	2.08	1.38
Computer Programs	1.03	1.29	.57

*$p < .05$.

Table 7

Mean Media-Utilization Scores for Negative and Positive Career Satisfaction Groups (Subscale 2 of Teacher Burnout Scale)

Medium	Negative Career Satisfaction Group (N = 71)	Positive Career Satisfaction Group (N = 132-134)	t
Filmstrips	1.56	1.99	2.14*
35mm Slides	.54	.71	1.26
Pictures from Books and Magazines	2.83	3.31	1.70
Games and Simulations	2.21	3.05	2.89**
Motion Picture	1.65	1.54	-.49
Video Tapes	.62	1.10	3.16**
Audio Tapes	1.17	1.71	2.30*
Phonograph Records	2.00	2.59	1.83
Overhead Transparencies	2.92	3.28	1.19
Models	1.59	2.47	2.74**
Computer Programs	1.14	.95	-.65

*p < .05. **p < .01.

Table 8

Mean Media-Utilization Scores for Negative and Positive Coping with Job-Related Stress Groups (Subscale 3 of Teacher Burnout Scale)

Medium	Negative Coping Group (N = 30)	Positive Coping Group (N = 116-118)	t
Filmstrips	1.50	2.01	1.76
35mm Slides	.43	.62	.87
Pictures from Books and Magazines	3.00	3.03	.09
Games and Simulations	2.63	2.91	.65
Motion Pictures	1.67	1.38	-.88
Video Tapes	.60	1.06	1.90
Audio Tapes	1.40	1.54	.39
Phonograph Records	2.30	2.35	.10
Overhead Transparencies	2.43	3.02	1.38
Models	1.20	2.33	2.69**
Computer Programs	.97	1.25	.63

**p < .01.

Table 9

Mean Media-Utilization Scores for Negative and Positive Attitudes Toward Students Groups (Subscale 4 of Teacher Burnout Scale)

Medium	Negative Attitudes Toward Students Group (N = 33)	Positive Attitudes Toward Students Group (N = 87-88)	t
Filmstrips	1.36	2.24	3.06**
35mm Slides	.45	.76	1.78
Pictures from Books and Magazines	2.48	3.45	2.45*
Games and Simulations	2.42	3.25	2.04*
Motion Pictures	1.79	1.66	-.41
Video Tapes	.55	1.16	2.58*
Audio Tapes	1.09	1.73	1.78
Phonograph Records	1.94	2.80	1.91
Overhead Transparencies	2.94	3.43	1.19
Models	1.79	2.52	1.72
Computer Programs	1.06	.95	-.27

*p < .05. **p < .01.

Examining the Effects of the Microcomputer on a Real World Class: A Naturalistic Study

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Examining the Effects of the Microcomputer on a Real World Class: A Naturalistic Study

> We know as little today about the effects of computers as we did about TV's effects in the mid-1950s. However, based on the pace at which children are beginning to use computers and the anecdotal accounts of their appeal and educational effects, children's learning from microcomputers has become an important topic for research. The first empirical studies of microcomputers and children are now under way at many universities and research centers. (Chen, 1984, p. 270)

While not immediately apparent, Chen's (1984) comments contain a disturbing fact. In spite of the very rapid introduction of microcomputers into the nation's classrooms (Chen, 1984; Kurland, 1983), we know very little about the effects of their prolonged use. Much early writing has focused on cognitive aspects of using computers, especially the cognitive consequences of learning to program (Papert, 1980). But more recently, interest in the social aspects of using computers has emerged. There are at least two reasons why a consideration of the social aspects of this technology are pertinent. First, as Chen (1984) notes, few schools to date have been able to afford to provide a computer for every child. Therefore, of necessity most instruction involving the computer has taken place with children in small groups or in pairs. Second, contrary to early fears that children working at computers would become isolated and too machine oriented, there has been some research indicating that computers encourage greater interaction and collaboration among children than traditional school instruction (Hawkins, 1983; Hawkins, Sheingold, Gearhart, & Berger, 1982; Sheingold, Hawkins & Char, 1984). Collaborative efforts among children have been lauded in the literature (Hawkins, 1983) and in Vygotsky's theories of cognitive development, but documentation of their occurrence with microcomputers is in its infancy.

The purpose of the study reported here was to describe and to analyze what happens when a microcomputer is introduced into an ongoing, real world classroom. The research paradigm assumed was naturalistic. Initial questions of interest were: How do children behave when confronted with a classroom microcomputer? Does the microcomputer encourage children to interact? What kinds of interaction seem to be precipitated by the presence of the microcomputer? How do children respond to the available software? How does the microcomputer influence the role of the teacher in the classroom? As is typical of naturalistic studies, unanticipated questions of interest emerged during the investigation.

The following report begins with a brief discussion of the naturalistic paradigm. Then the setting in which the study took place is described. The following results section presents the themes that emerged during data collection and analysis. The report concludes with recommendations for additional research suggested by this study.

Methodology

The research paradigm assumed for the study was naturalistic. As Sheingold, Hawkins, and Char (1984) have noted, the social life of the classroom cannot be studied via experimentation alone. The use of experimental methods introduces control and intervention in the classroom that renders a disturbed rather than a naturally occurring setting. Furthermore, the complex and fluid nature of human interaction does not lend itself to control and quantification.

The rationale for using naturalistic inquiry to pursue studies such as this one has been described by Guba (1982), Guba and Lincoln (1983), Patton (1980), and others. Basically, the naturalistic paradigm is distinguished by three assumptions. The first is that reality is holistic--all parts influence all other parts. It is impossible to divide up reality into discrete variables as experimentalists do, holding some variables constant while manipulating others, without destroying the phenomenon under investigation. The second assumption is that the researcher must be involved with the phenomenon in order to understand it; the researcher tends to become the instrument rather than relying exclusively on tests, questionnaires, and other so-called objective devices. Third, context free generalizations or laws are not deemed possible by naturalistic inquirers. Rather they seek thorough description of phenomena so that working hypotheses may be applied to other similar settings.

The study reported herein sought to understand what happens when a microcomputer is introduced into an elementary classroom, not what can happen in a laboratory school, but what does happen in a real class. As is typical of naturalistic studies, several sources of data were examined. Observers were present in the class approximately three hours a week for four months. In addition to their field notes the data base contains a fourteen hour videotaped record of the children using the microcomputer. The videotape was transcribed for analysis. All of the children were asked to complete a questionnaire regarding their preferences for alternative instructional media, microcomputer software, and partners when working on different kinds of tasks. The questionnaire was followed up with an individual interview of each child seeking clarification of their responses and additional, non-verbal information.

The study was conducted in a combined 2nd and 3rd grade classroom in a private elementary school. The school is located in a small rural community in southern Illinois. Twelve students, between the ages of seven and nine years of age participated in the study. Their teacher was completing her first year of teaching. She, like the children, had received a brief orientation to the computer and how to use it. In addition, an introduction to the available software was included in this orientation.

An informal, relaxed atmosphere pervaded the classroom with children working independently and confidently within it. Learning centers were available within the room, and children walked freely from one to the other in pursuance of their preassigned academic responsibilities for the day. The computer was introduced into the classroom as an additional center. A conscious attempt was made to insure all children had an opportunity to use the computer, and specific students were assigned to it singly, in pairs, or in small groups. When computer usage had not been specifically scheduled, optional access was available.

During a two week period prior to the initiation of the study, the two observers, the video operator, and the video equipment were introduced into the classroom. The researchers became accepted as part of the class, while the children were allowed to become familiar with the camera and how it worked. Actual taping began the week immediately following this orientation and the introductory orientation to the computer. The camera was placed in a spot convenient to the computer. Since the study focused upon the computer and the children's interactions with and around it, it soon became apparent that the camera could be set and left virtually unattended during the course of each session. Thus, the unobtrusiveness of the equipment and operator was enhanced.

Data analysis followed a typical qualitative approach. The data were reviewed and tentatively coded. A content analysis was conducted, and themes in the data identified. At this writing the data analysis is far from exhausted. The results presented here are preliminary and further data analysis using alternative strategies progresses.

Results

The results of the study are described below as themes that emerged during data collection and analysis. The following results should be viewed as tentative. Their validity is threatened because, while the children were observed for a longer period of time than that frequently allowed in experimental studies, a much longer period would be required before confidence could be placed in the results. In spite of their limitations, the results provide a good starting point for forming hypotheses to be pursued in future research.

Differences in Response

Not surprisingly there appeared to be differences in the ways individual children responded to the microcomputer. Some of these differences are described below.

Differences in enthusiasm. Clearly not all the children responded to the microcomputer with the same level of interest. Such differences are not discussed in most of what is written about microcomputers; merely reading the microcomputer literature can leave one with the impression that all children are naturally drawn enthusiastically to this technology. Such a notion appears to be a myth. Detecting differences in interest level appears to require observation of children with computers. When children were asked during their interviews whether or not they liked the school's microcomputer they all answered that they did. When asked on a questionnaire to choose among worksheets, television programs, and the microcomputer for work in math and in language, the computer was generally selected as the preferred medium, and was never the least preferred. However, when observing children at the microcomputer and during those periods of optional access, it was apparent that some had an avid interest in the machine, while others gave it only superficial and fleeting attention.

Sex differences. The results of this study lend some support to the sex difference in response to computers already suggested elsewhere in preliminary research (Becker, 1982; Hawkins, 1984). As noted above, observing children working with computers is essential for exploring these differences; when interviewed or asked on the questionnaire, girls and boys alike expressed favorable attitudes toward the microcomputer. However, the observation data seem to indicate a difference between the girls' and the boys' behavior at the machine. The boys seemed more interested in getting the machine to perform different functions. Hawkins (1984) stated the phenomenon well, "Boys wanted to control it" (p. 12). The girls seemed more likely to use the drill and practice programs--to stay within the dictates of the established program rather than to explore the machine's capabilities. Hawkins (1984) has speculated that the sex difference may be due in large part to the curricular pairing of computers with math and science subjects, thus invoking the societal sanction against female involvement. However, during observations of the classroom viewed for this study, the microcomputer was never designated as a subject allied with either math or science. The available software involved language and music as well as math. These tentative outcomes do not appear to support Hawkins' hypothesis.

Age differences. Among older children, it appeared that the frequency of interaction surrounding the computer tended to decrease during the four months that the class was observed. A similar decrease, however, did not seem to occur among the younger children. This finding may be partially explained by the younger children's continuing need for assistance in simply operating the computer--loading the software and setting software parameters.

Class Management

Some of the study's results seem to have implications for class management.

Computer mechanics. An analysis of children's behavior and interaction when using the microcomputer revealed that a substantial portion of their 'computer time' was spent in simply trying to get the computer to run the chosen software. Technical and logistical problems were frequent. The teacher or the child 'expert' was called repeatedly to correct these problems. It was not uncommon for the teacher to call in the child 'expert' when the problem was one she could not handle. Children were observed waiting and waiting and waiting for such assistance before they could progress through a program. Needless to say, such episodes seemed to generate frustration for the teacher as well as the children. Much of the time that the children spent at the computer was unproductive.

Computer rights. Also revealed by the analysis of children's interaction when using the computer was the surprising frequency with which the children had to assert verbally or nonverbally their right to control the computer keyboard. While the total amount of time taken by these squabbles was not great, their effect was to interrupt task oriented behavior. When more than two children were present at the computer, this behavior became even more pronounced. Hoarding of the keyboard, pushing away hands, and verbal reprimands were common in such situations. The child seated at the computer was frequently beseiged with 'advisers' usually offering conflicting advice. This situation may have been aggravated by a characteristic of microcomputers in schools noted by Sheingold, Hawkins and Char (1984) and by Hawkins (1983); microcomputers have not yet become an established part of the curriculum. Their legitimacy in the eyes of teachers and therefore also of students has not been confirmed. Consequently, children are more likely to interact freely where computer tasks are concerned; the taboos surrounding not doing one's own work seem not to have taken hold of computer tasks yet.

Role of the 'child expert'. The impact of microcomputers on formal educational settings is only now beginning to be studied, while the impact of personal computers on the home setting is yet to be explored. The accessibility of personal computers in the home has created the unique phenomenon of the child 'expert'.

The child 'expert' in the current study was called upon by peers and teacher alike for technical and logistical assistance. Many children appealed to him for approval of their creative endeavors. But, noticeably absent from any of the resultant interchanges were the mature interactive behaviors one would expect from an adult teacher expert. Hyman (1974) states clearly ".... there is an interpersonal aspect of teaching, in which the teacher must encourage learning and must himself respect 'intellectual integrity and capacity for independent judgement'" (p. 25). It would appear unlikely that many child experts would be capable of developing such a relationship with their peers. Thus, the role of the child 'expert' should be explored systematically.

Role of the teacher. This study seemed to indicate that the introduction of the microcomputer into the classroom placed many additional demands on the teacher. In addition to the more obvious demand that the teacher master the technology were the increased classroom management tasks. As noted above, the teacher was very frequently interrupted when working with other children to come to the aid of the child using the computer. The teacher's monitoring of the children's access to the machine also drew her frequent attention; she repeatedly had to instruct children to leave the computer area. Finally, choosing appropriate software for classroom use is an additional responsibility the teacher must assume.

Software evaluation. Char (1983) suggests three major criteria which should be used in determining the appropriateness of software for classroom use: comprehensibility, appeal, and usability. Observations of children's reactions to the available software in this study were analyzed in relationship to these factors.

Some children in the study frequently appeared confused not only by the general objectives of some of the software assigned them, but also by the mechanical processes involved in 'making the program run'. Others were clearly unchallenged by the same software, while a few children were interested, challenged and obviously happy with the tasks presented them. These observations support Char's findings (1983) in suggesting the use of comprehensibility as an evaluative criterion in choosing software, and support the demand for a wide variety of software designed for various skill and conceptual levels.

As mentioned earlier, different software appealed to different children. While girls seemed to prefer drill and practice, boys appeared to prefer software which allowed for creative control of the computer. Responses of all children using drill and practice programs highlighted some unique problems for program designers. It was apparent that the program's 'positive' rewards for correct responses to the provided stimuli were not always appropriate for the individual user. Some children engaged in silliness as they made faces at the computer and mimicked the sounds it made in recognizing their success; some expressed disgust at the repetitiveness of the reward and actually lost sight of the drill and practice goals, intentionally making errors in order to change the computer's response; others expressed their boredom as they waited impatiently for the completion of the reward in order to get on with the rest of the program. Many available programs have overcome the difficulties associated with timing responses to meet individual performance needs, but more research is needed to discern appropriate and varied 'rewards' for successful task completion. It appears incorrect to assume that all children are highly motivated by the same rewards.

An earlier reference to the boys wanting to control the computer keyboard focuses on the third criterion, that of usage. The behaviors observed in this study support the need for the creation of more software which can be used effectively by more than one child at a time.

The naturalist research paradigm employed in this study allowed observations of the interactions of children around a computer in a real classroom. Analysis of those observations suggests the need for further research into problem areas affected by the computer's presence in the classroom. Areas suggested for further study include: the relationship of differences in sex, age, and cognitive style to computer usage; the identification of additional demands upon the teacher for technical knowledge and skill in evaluating software effectively; the identification of the effects on a child of assignment to the role of class 'expert'; and, the design of more and varied software which meets the criteria for successful usage.

It was obvious throughout the study that the presence of a computer in the classroom is far from enough to assure advances in learning. The computer is merely another teaching tool whose success is dependent upon the way in which a well-prepared teacher can accommodate the additional knowledge, classroom management techniques, and software design awareness that s/he will need to use the computer effectively.

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SOCIAL INTERACTION ANALYSIS of an ELEMENTARY SCHOOL STUDENT and a VIDEODISC SYSTEM in an EDUCATIONAL ENVIRONMENT: A PROGRESS REPORT

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BACKGROUND TO THE PROBLEM

Examination of life in the classroom centers around myriad aspects that surface in the educational environment. Most often educational research focuses upon strategies and stimuli designed to produce a particular type of performance outcome. Research instruments are usually designed in behavioral form and interpreted through quantifiable and measurable objectives. The picture is usually completed through the use of various psychological aptitude and achievement tests that illustrate the effectiveness of the particular strategy or stimulus.

While certain aspects of the classroom may be captured by this psychological model, others are not. Research of this kind looks at education in a vacuum, and concentrates on the individual and individual behaviors. Occassionally there is an exploration of mental processing, as in cognitive psychology. Relationships are reduced to a set of stimuli and responses, or hypotheses and feedback. Social interaction analysis, instead of limiting its investigation to interpretation of the results from some predetermined superimposed structure, attempts to investigate the meaningful patterns and rules of usage in social behavior by examining it in its situational context.

The emergence of new technologies in the classroom setting is nearly always met with the former model of research. Various media, whether print, photography, film, television, audio, video, or computer are investigated to determine their psychological impact.

Sometimes the particular attributes of a medium are assessed to identify which ones might best deliver certain kinds of messages to certain kinds of learners doing certain kinds of tasks (Salomon,1979). Again, this is an application of a particular structure, some medium or medium attribute, used as a stimulus, to provoke some form of response. Results from this kind of experimentation yield quantitative conclusions that can be used to predict similar outcomes in similar situations. However, such situations rarely exist. In this model the setting is controlled; the individual (subject) being examined is considered neutral and without intentions, and the relationship among existing variables, the social interaction, is ignored.

Few children come to thes classroom today without some form of social relationship with the media. Educators need only listen to the conversations among students on the playground, in the halls, or at lunch, to recognize tht such a relationship exists. Research that ignores the intentions of such individuals when they interact with media in an educational setting presents a subtle form of distortion. Research that allows the individual (participant) the opportunity to give an account of her/his relationship, and describes the setting in which the interaction takes place, attempts to eliminate this form of distortion.

Media, and their accompanying technologies, have evolved from ink on paper to light upon a chemical emulsion to electronic signals upon a screen. The last, electronic technology, has allowed the combining of a visual medium, video, with a computational medium, computer, to form a hybrid known as "interactive video." In order to further accomodate this new medium certain technological developments have and continue to occur. One development of interest to researchers in educational technology is the videodisc. This software and accompanying devices used in its operation are considered to have a dynamic quality that does not exist with video tape. From a simple physical examination this would seem apparent. Tape is linear, and to get from one point in its presentation to another all the tape in between must pass by the electromagnetic head which then reads the information desired. For this reason, most material produced for videotape is sequential or linear in form. On the other hand, a videodisc is made up of concentric circles, and to get from one point in its presentation to another a laser beam moves angularly across one of the radii of the disc. This provides the opportunity to produce material that is not sequential or linear, but randomly accessible and dynamic in form. (Bennion and Schneider, 1975; Love, 1979; Kemph, 1981; Onosko, 1982).

Instructional media research has focused on the application of this medium in the role of individualized instruction. Bunderson (1979-1980) acknowledges that videodisc technology combines two traditions: the artistic tradition of motion pictures and video, and the analytic and empirical tradition of programmed and self-paced instruction. Representative of the predominate view, Bunderson assigns strong motivational features to the former, and instructional facilities to the latter. The use of behavioral analysis, which breaks the program into stimulus-response steps for the learner to follow is considered to produce "more relevant behaviors." The use of critical analysis, coming from the artistic tradition, or critical viewing skills used to interpret information presented, is not even considered in this discussion of instructional methodology.

Elsewhere, Bunderson (1981) states the need to merge the three traditions to achieve the most effective ISD (Instructional Systems Development) model. Again, the artistic tradition, exemplified by motion picture sequences, is seen as being "limited in the cognitive instructional content" area. Bunderson argues that these sequences require most of the information be carried in the audiotrack, since visual presentations require "slowpacing" to be effective. In contrast, Arnheim (1969) views all thinking as a product of perception and visual imagery. In this argument, mental images, which include pictures, symbols, and signs, are seen as a precursor to thought.

In their discussion of systems employing videodisc technology, Allen and Allen (1983) stated that successful users expand traditional behaviorist and criterion-referenced models to include focused discovery, cognitive and affective domains, and Social Learning Theory with its awareness of interactions among behavior, cognition and environment. This statement coincides with Molnar's (1979-1980) observation that current instructional paradigms are inadequate for new technology and innovation.

In discussing an "interactive" medium, it is important to realize that interactions are not always explained by an S-R or cognitive model. Pressing buttons in response to visual stimuli do not constitute the entire set of interactions between a student and a videodisc system in an educational setting. Many interactions result from the cultural context of the classroom. Meaningful patterns of social behavior, and the rules of usage governing relationships, and interactions emerge from the situational context.

While behaviorist, cognitive and other psychological paradigms may permit the formation of models in which students respond or process certain stimuli, they are unable to explain the dynamics of social interaction. This limitation of these paradigms makes it difficult, if not impossible, to adequately research "interactive video." Therefore, in order to properly conduct this study of interactivity, it is necessary to reach beyond the parameters of current educational research paradigms. This study utilizes the social interaction analysis paradigm to discover the relationship between elementary school students and a videodisc system in an educational environment.

STATEMENT OF THE PROBLEM

The purpose of this study is to observe the relationship between elementary school students and a videodisc system in an educational environment. Rather than examining the developmental effectiveness this "interactive" medium has upon students, the study explores the larger question of what kinds of interactions are exhibited when students and videodisc technology are brought together in an educational setting. This investigation is aimed at disclosing meaningful patterns (Blurton Jones and Woodson, 1979) of social behavior that develop through the observable features of the preceding, contemporary and subsequent behaviors of students and the medium in such a setting. Through comprehensive analysis of these patterns this study provides information that will permit the effective implementation of curricula that bring together elementary school students and videodisc technology in an educational environment.

In order to examine the full range of phenomena that develop when a videodisc system and elementary students coexist in an educational setting, a social interaction theoretical framework is used to direct this research. This paradigm permits the observer to examine the intentions of the students, the impact of the environment, and other non-quantifiable information that may be pertinent to the development of a comprehensive analysis.

STUDY GOALS AND OBJECTIVES

1) What kinds of meaningful patterns emerge through the observation of social behaviors that occur between an elementary school student and a videodisc system in an educational environment?
2) During the course of the interaction between the elementary school student and the videodisc are these meaningful patterns more often examples of acceptance or resistance?
3) During the course of the interaction do elementary school students exhibit more active or passive behavior when interacting with a videodisc system in an educational environment?
4) Do elementary school students that have interacted with a videodisc system in an educational environment perceive the system to be "friendly," "intelligent," or able to carry on a "conversation" or

"dialog?"

5) Are any meaningful patterns of social interaction between elementary school students and a videodisc system in an educational environment gender specific?

6) What implications would these meaningful patterns have for curriculum development which includes the utilization of videodisc technology?

7) What implications for further research may be derived from this study?

ASSUMPTIONS

Educational environments provide an arena for both the cognitive development and social interaction of their inhabitants. While the relationship between instructional events and the students' cognitive ability mediate what is learned, there is a tendency on the part of educational research to focus on mental events. Elementary school classrooms and media centers are communal settings in which students evolve from a collection of individuals into "working social groups" (Amarel, 1983). The social interaction of students with each other and with the environment is a determinant of educational productivity.

Survival requires that in a social context individuals be able to behave both cooperatively and competitively. Evidence of both cooperative and competitive context have been found in research of educational environments (Slavin, 1983; Johnson and Johnson, 1975; Vereen, 1983). In most educational situations the cooperative context or behavior exhibiting acceptance is more desirable and condusive to learning.

Children have experiences that lead to the formulation of concepts, attitudes, and opinions long before their first school experience. Many of these early experiences, along with many others outside of school, influence the perceptions and expectations of a child. Some of these undoubtedly influence their behavior in school. Experiences outside of school influence students' intentions toward, as well as their expectations and perceptions of, the educational environment.

DEFINITIONS of KEY TERMS and SYMBOLS

Videodisc system: A system of a videodisc player, color monitor, and a videodisc. In some instances, a microcomputer, interface device, computer software, and additional monitors are included. In this study, a level one (Kemph, 1981; Onosko, 1982) or manual (Bunderson, 1979-1980) videodisc player, a videodisc with a program specifically designed for this medium, and a color monitor are used.

"Interactive video": An electronic medium that incorporates still, motion, and text on the visual track, and synchronized and non-synchronized sound on two separate audio tracks. User choice is inherent in the medium and is administered through control over the pace and sequence of the presentation (Bunderson, Hoekema, Hon, Wilson, Worcester, and Woodward, 1983). Features that facilitate this behavior include fast random access, freeze frame, forward and reverse, slow, fast, step, and "real time" motion, and mono or dual audio selection.

Levels of interaction: Capabilities of videodisc systems are refered to as levels of interaction (Bunderson, 1979-80; Kemph, 1981; Onosko, 1982).

Level One refers to a "manual" commercial optical videodisc player capable of a mixture of still and motion sequences, and which permits the user to select portions and control the pace of the presentation.

Level Two refers to an educational/industrial optical videodisc player capable of automatically branching users to parts of the presentation for review, reinforcement, etc. Some simple forms of scorekeeping are also possible by programming the player's microprocessor.

Level Three refers to an educational/industrial optical videodisc player interfaced with a microcomputer capable of generating graphics and text, editing questions, and keeping detailed records. The microcomputer program can guide the entire presentation and evaluate all responses.

Social interaction: The interrelationship of a set of overt behaviors, verbal and non-verbal, of an individual(s) in a social environment.

Educational environment: The total set of circumstances surrounding an instructional event. In this study, the total set of circumstances includes the physical and social dimensions wherein an instructional event occurs. The physical dimension is referred to as the videodisc system and the classroom, instructional media center, or laboratory setting. The social dimension is referred to as and inclusive of all

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events in the instructional context (adapted from Vereen, 1983).

SSR (Senders, Signals, and Receivers) System: An empirically derived method for catergorically recording observations of complex social interactions. The method includes keyboard entry and computer transcription of grammatically structured strings of characters that are used as codes to describe the observations. The defining properties of the codes reduce redundancy in the entries and direct the flow of Program PLEXYN (Stephenson, Smith, and Roberts, 1975; Stephenson, 1979).

PLEXYN: A computer-compatible grammar processing program that verifies, completes and reformats SSR system code into a record for subsequent data analysis.

DELIMITATIONS of the STUDY

This study is limited to upper elementary school students. The sample is drawn from a middle sized urban community in the Midwest. The socioeconomic status and ethnic background of the sample is diverse, but consists primarily of white middle class students. No attempt has been made to randomize the sample, therefore, the results of ths study are not generalizable beyond this or similarily constituted populations.

Analysis of social behavior is limited to an educational environment, and does not attempt to answer questions regarding videodisc systems in training or entertainment. Any implications that may be found in this study as regard these areas would require further research.

THE REVIEW OF RELATED LITERATURE

The review of literature in this chapter is comprised of both theoretical and empirical research related to this study. The review consists of literature from videodisc research and a chronicle of the historical developments leading to its use in education; educational paradigms currently used in the research of videodisc and other innovative technologies; theoretical and methodological issues in social interaction analysis; and, research on the observation of children.

VIDEODISC SYSTEMS: HYPE or HOPE?

> The promises of video disc hark back to those days in the late 19th century when man first perfected a reliable means of mechanically reproducing sound. The Americans Alexander Graham Bell and Thomas Edison, the Frenchman Charles Clos, the Italian Guglielmo Marconi and the Dane, Valdemar Poulson with their inventions of the telephone, phonograph, radio and mechanical recording device, discovered how to convert sound into electrical impulses and then back into sound (Sigel, 1980).

These same principles were applied in 1927 when John Logie Baird developed "Phonovision", the first, however crude, version of a videodisc system (Schubin, 1980). The next major developments in video occurred after World War II with the introduction of the video tape recorder. Video returned to a disc format in 1965 when Magnetic Video Recording provided CBS television with a magnetic disc for producing stop action and instant replay. This videodisc system continues to be the "backbone of sports coverage" (Schubin, 1980).

Two types of videodisc systems have been developed during the

1970s and first part of the 1980s. The first, or contact systems, developed by TelDec (Telefunken of Germany and Decca of Britain), JVC, and RCA, use styluses that make contact with the surface of the disc, and resemble phonograph technology as it appears during this time period. The second, or optical systems, developed by Philips, MCA, Thomson-CSF, and Sony, use laser styluses that never touch the surface of the disc, but send a beam of light that is either transmitted through or reflected off the disc to a decoding device that reads the electronic signal (Schubin, 1980). Characteristics unique to the optical videodisc system make it the only practical model to be used for educational purposes, hence any further reference in this study to videodiscs, videodisc systems or videodisc technology should be regarded as referring to this type of format.

Bennion and Schneider (1975) were among the first to move from mainframe directed video/slide presentation for individualized instruction to the world of video contained in a single videodisc system. Comparisons were immediately made between potential applications of videodisc systems and the Time-shared Interactive Computer Controlled Instructional Television (TICCIT) project of programmed instruction that they were involved with at that time. Advantages of the videodisc system over the TICCIT project according to these researchers was its greater audio capabilities, motion control, and lack of reliance on an external computer.

Schneider (1975) attempted to make a case for the cost efficiency of videodisc over other media by doing a per unit comparison. While mass production of the disc may be low in this comparison, costs for commercial production of content for this medium have been estimated, elsewhere, at between one and three thousand dollars per minute (Kehrberg and Pollack, 1982; Hiscox, 1982; Eastwood, 1978-1979; Paris, 1981), and necessarily drives the per unit cost up. For industrial training investments of this type may not be a deterrent in the development of the videodisc, however, in education expenditures of this size are a cause for concern.

Other researchers involved with the development of programmed individualized instruction started to advocate the implementation of videodisc systems (Bork, 1978-79; Bunderson, 1979-1980; Molnar, 1979-1980). Most of the research focused on the potential for "full multimedia " (Bork, 1978-79) instructional programs on stand-alone systems, or a "dry laboratory", where students can work, or "intelligent electronic books" (Molnar, 1979-1980) for students to query. The failure to modestly appraise the potential of this technology in favor of lauding the way it so neatly fits into the programmed instruction model is evident in Bunderson's (1982) acknowledgment that researchers at the Waterford School, a prototype for this method of instruction, anticipated learner productivity to improve ten to a hundred fold after the implementation of this technology.

Paris (1981) argues that the many "myths" surrounding research of videodisc technology could create false expectations and actually inadvertently hurt its development. Rather than imagine "future" possibilities, research should focus on what the technology "can do today." Among the misconceptions, proliferated at the time of Paris' writing, were the following ones which she attempted to debunk; videodisc will replace the book; typewritten office material is compatible with videodisc technology (The aspect ratio of typing paper and television screens are not compatible.); the Encyclopedia is readable when stored on a single videodisc; and, information can be cheaply stored on videodisc.

Hiscox (1982), also, cautioned against overstating the significance of videodiscs in education. Attempting to find a suitable method for curriculum development in the remote areas of Alaska, he considers videodiscs to have only a limited role in instructional situations. Reliability of equipment (hardware), complexity of the instructional program, difficulties in evaluating and revising disc-based programs, and costs of "interactive" videodisc systems were sited as deterrents. Implementation of videodiscs, according to Hiscox, "...suffers from severe practical limitations and is not likely to have a substantial impact on teaching methods in the next decade."

Eastwood (1978-1979) presented numerous deterrents to educational use of "intelligent videodisc" systems. Among these were the lack of faculty incentives to adapt this new technology, a lack of skilled personnel and appropriate facilities for videodiscs, a resistance to change in education, and the maintenance of the traditional role of the teacher. Amarel (1983) concurs in her study, which reveals adoption of innovation and technology into the curriculum depends "on such factors as the teachers' assessment of the quality and value of the lessons relative to their own instruction, on the amount of disruption they were willing to tolerate, and on the firmness with which they held to their customary teaching practices."

Another problem Eastwood (1978-1979) points out is the lack of valid educational research about videodisc technology. While proclamations about potential may stir interest, the critical nature of education requires research to substantiate claims made concerning pedagogical effectiveness. Unfortunately, despite rapid growth in training applications, videodiscs have received only minimal utilization in education. As a result, what follows is a nearly exhaustive summary of research completed at this time.

The most sophisticated videodisc technology was developed by the MIT Architecture Machine Group (Backer, 1982). The program is designed to teach the fundamentals of bicycle maintenance and repair. The design incorporates diagrams, exploded views, and continuous sound.

At the other end of the spectrum is a program teaching economics to high school students in sparse areas of Minnesota. This program was designed on a shoestring budget by Kehrberg and Pollack (1982).

An area that is growing in the utilization of videodisc technology is special education (Thorkildsen and Allard, 1982; LaGow, 1979-1980). Reading programs for the hearing impaired and the mentally handicapped were the subjects of these videodisc projects.

Making use of old film footage to teach a lesson in physics limited the cost expenditure of producing the Tacoma Narrows Bridge Collapse (Zollman and Fuller, 1982).

Bunderson (1979-1980) designed a biology program for a manual videodisc player, such as the one used in this study. The program requires students to use study skill analagous to those used to find information in a textbook.

Perhaps the most ambitious research and development was the effort of Kirchner (1982,1983), who both produced and field tested an elementary health program about the heart and circulatory system.

METHODOLOGY

The purpose of this study is to analyze the social interaction between elementary school students and videodisc systems in an educational environment. A triangulated design utilizing empirical, analytical, and critical models of data collection directs this study. The first part of the design is the observation. An interview with each of the participants follows the conclusion of the observations. The third part of the investigation is a survey of the parents and teachers of the students. Each part of the design will be treated separately in sections of this chapter.

SAMPLE POPULATION

The sample population for this study was drawn from a small midwestern urban environment of approximately 175,000 inhabitants. Most of this community consists of governmental workers that service the university or state agencies that are centered in this city. There is some light industry, as well as some commercial enterprises in the central city and areas around the periphery of the city. School enrollment decline has tapered off, and there is discussion about reopening some schools that were closed during the decline. Presently, the school district is undergoing school "pairing" as part of a desegregation program that was initiated during the current school year. Both schools, the one that served as the site of the pilot study, and the one that served as the site of the final study, were cited by the district's human relations director as having a diverse population.

The intact groups that comprised the pilot study and final study were one third and two fourth grade classes, respectively. The pilot study will be discussed in more depth later in this chapter. There were nine girls and ten boys in one fourth grade class, and eight girls and twelve boys in the other fourth grade class. Three black and sixteen white children made up the nineteen members of the first class, and two black and eighteen white children made up the twenty members of the second class. All classes were heterogeneously grouped, and reformed to constitute homogeneous groupings during math and reading lessons. Students participated in the observed interaction with the videodisc system only in their "homeroom."

Achievement scores were not available, but reading groups ranged from nearly a year behind in the basal series to a year ahead. In one math class the investigator was present when the teacher showed a film reviewing basic multiplication and division facts, which most of the class seemed proficient at answering, as observed by their responses to problems posed in the film and wallcharts indicating their scores on speed drills.

While a videodisc player and accompanying software have been available in the school district for the past three school years, the implementation of this technology has been nearly non-existent in the curriculum. According to the school district media director, and from other inquiries made by the investigator, the best assessment is that videodisc systems have encountered limited utilization at the secondary level and almost no utilization at the elementary level. Several reasons for this failure were given by one of the fourth grade teachers involved in the study in an informal interview. First, unlike movie and slide projectors, which are present each school, a videodisc player must be retrieved from the central administration building. Second, according to this teacher, "...you practically have to sign your life away," in order to acquire this equipment. The lack of quality software was given as the final deterrent.

PILOT STUDY

The third grade class involved in the pilot study was in a neighboring school to the school which housed the fourth grade classes involved in the final study. Eleven girls and eight boys made up the constituency of this class. Two black, two native American, one Hispanic, one Vietnamese, and thirteen white children made up the nineteen members of this class.

All the instrumentation and procedures for the observation, interview, and survey were the same as those used in the final study. The only difference is that the raw data recorded by the SSR Keyboard was not transcribed by Program PLEXYN for further analysis. The purpose of the pilot study was to develop proficiency in the use of the instruments, and to help refine the behavior categories. More information about behavior categories follows in the next section on instrumentation.

INSTRUMENTATION

The instrument for the observation was the SSR (Senders, Signals, and Receivers in Stephenson and Roberts, 1977) system keyboard for recording communication events, along with Program PLEXYN (Stephenson, 1979), a computer-compatible grammar that transcribes character strings typed in by an observer, and which permits the rapid coding of complex social interactions without the observer having to look away from the events being recorded. A program was written that allowed the investigator's Apple IIc to simulate the SSR keyboard. Each student record was stored as a separate file on a floppy disc. Files were later transferred to an IBM-DOS floppy disc for reformatting and transcription by Program PLEXYN.

The following model was devised by the researcher to enable a theoretical perspective for analyzing the complex social interactions exhibited when elementary school students interact with videodisc systems in an educational environment. First, student social interaction can be characterized as belonging in one of two large domains. Either the student accepts the educational experience, or s/he resists the educational experience. This can be further divided into four distinct states of the social system: active acceptance, passive acceptance, passive resistance, and active resistance. Each of these manifests itself through various patterns of behavior that can be distinguished from each other by their level of intensity. The following table (see Table 1) illustrates these manifestations.

TABLE 1
MANIFESTATIONS of the SOCIAL INTERACTION SYSTEM in ELEMENTARY SCHOOLS

	LIMITED	MODERATE	EXTREME
ACTIVE ACCEPTANCE	Enthusiastic	Energetic	Exuberant
PASSIVE ACCEPTANCE	Docile	Compliant	Obedient
PASSIVE RESISTANCE	Indifferent	Nonchalant	Obstinate
ACTIVE RESISTANCE	Flippant	Disobedient	Hostile

All of the observable behaviors fit into these twelve categories.

Many of the initial behaviors in the first behavior catalogue were derived from other observational studies, and the researcher's own experience as a teacher in an elementary school classroom. For the pilot study a list of over one hundred behaviors were defined and put in the catalogue. After the pilot study more than one third of the original behavior categories were removed because they failed to appear even once, and were assessed upon reflection as being highly unlikely to occur. An additional fifteen new categories emerged during the pilot. In all, seventy-four behaviors were defined and used in the final study

Analysis of these behaviors, and placement in the correct classification in the social interaction system is dependent on not only the incidence of the behavior, but its duration, repetition, and sequence of occurence. Program PLEXYN through its fourteen defining categories searches for errors in recording, removes redundancy in the record, turns off categories through mutual exclusion (i.e, a student cannot cut and fold paper at the same time), and permits the insertion of subjects and objects by default (i.e., slow motion has the videodisc system for its subject, while reads screen has the student for its subject and the videodisc system for its object). Through careful investigation of the data meaningful patterns emerge

The instrumentation for the interviews and survey will be explained in the following sections.

INTERVIEWS

Interviews were conducted with seventeen of the nineteen students in the pilot, and thirty-eight of the thirty-nine students in the final study. The reason for the exclusions in all three instances was due to student absence. The original intention of the researcher was to conduct interviews following the observations to enable the line of inquiry to pertain to the particular behaviors observed. Unfortunately, in securing permission to conduct this study it was necessary to prepare any questions to be used beforehand for approval by the external research committee of the school district. The following questions (see Table 2) were asked of the students after completion of the observations.

TABLE 2: STUDENT INTERVIEW

(Interviews with students were tape recorded.)

1. What is your name? (This was done to gain rapport. Anonymity was assured.)
2. Briefly, state what you learned from working with the videodisc system.
3. What did you like about this method of learning?
4. What didn't you like about this method of learning?
5. What other things do you think could be learned using a videodisc system? Give some examples.
6. Did you feel comfortable using the videodisc system? Why (or, why not)?
7. Did you think the videodisc system was "friendly?" Why (or, why not)?
8. Did you ever think you could "talk to" or carry on a "conversation" or "dialogue" with the video program? (If so, tell why you thought this, and if there were any particular times when you thought this "conversation" occurred.)
9. Did the videodisc system seem "smart" or "intelligent?" Why (or, why not)?
10. Did you feel like you were in control of the lesson, or did the lesson seemto control you?
11. Did you ever feel nervous? Why?
12. How much computer experience have you had at school? home? elsewhere?
13. How much video experience have you had at school? home? elsewhere? Did any of this include the use of a videodisc system?
14. How often do you watch television at school? home? elsewhere?
15. Do you ever play arcade games? Where? How often?

SURVEYS

The final part of the investigation was a survey of the parents, teachers, and administrator of the students involved in the observations and interviews. Again, the intention was derive statements from the observation and student answers to questions, however, prior approval was necessary to secure permission to conduct the survey. The following table (3) provides the statements to which parents, teachers, and administrator were asked to respond. A line with a continuum from strongly agree to strongly disagree with uncertain in the middle was provided on the distributed surveys.

TABLE 3: PARENT and EDUCATOR SURVEY

1. Students need learning experiences utilizing videodisc systems.
2. Students are less apprehensive than teachers about advancing technology.
3. Students need to learn about videodisc systems and computer technology at school.
4. School curriculum is too overloaded already to add videodisc and computer studies.
5. Software selection is as important as textbook selection.
6. Videodisc systems and computer technol ogy dehumanize schools and classrooms.
7. Students work better with machines, such as videodisc and computer systems, than they do with each other.
8. Interpersonal skills development decreases among students utilizing videodisc systems and computer technology.
9. Conversation or "dialogue" with "artificial intelligence" is possible.

PROCEDURES

Each class participating in the study took a week to complete the observational portion of the investigation. At the start of each of these weeks the class under investigation was given a presentation explaining what a videodisc system is, and how it works. Explanations are given and a demonstration of how to use the remote control device to obtain "real time," slow motion, fast motion, still frame, step frame, and reverse is illustrated. The steps for finding a new chapter on the First National Kidisc were outlined, and some of the chapters were previewed. This software was selected because of the different types of activities and various interests it provides for, as well as the opportunity to give the student control over the widest possible choice of the kind of interaction desired, while at the same time providing an instructional task to be performed. The First National Kidisc was not specifically designed for use in education, but an educational consultant was part of the production staff (Blizek, 1982).

A schedule was drawn up by the teacher and researcher assigning thirty minute periods for each child to work with the videodisc system. Periods when students were working with specialists, such as the art, music or physical education teacher, were avoided.

The videodisc system was set up at the far end of each room in learning center fashion. The learning center consisted of a desk with supplies stored inside for paper folding, knot tying, secret code chart construction, and flip books (simple animation). The 19" Zenith color television that served as the monitor was placed at eye level in front of the desk. This was a major improvement over the pilot study which had a cart that forced the students to look up at the monitor. In both classrooms in the final study the Pioneer VP-1000 Videodisc player with the First National Kidisc already inside was placed to the students' right-hand side. In the first classroom since the desk was so large the player was set right on the desk. In the other classroom it was placed on a cart the same height as the desk.

Two charts, one with instructions reviewing the items given in the class presentation and another with the various chapters for selection from the software were at the station so the student may work independently. These were placed flat on the large desk in the first classroom, and were held up by chart stands above the monitor and videodisc player in the other room. The remote control device was set on the desk in each classroom.

The first five minutes of each period were spent reviewing procedures presented in the original class orientation. Students were given a chance to attempt a chapter search, and to ask any questions about the procedures they might have before beginning the lesson. Once the student was ready, the video camera that was at a right angle to the student's right side was activated. The computer program was booted and the observer, who because of limited space had to sit on the same side of the student as the video camera, began to record the social interaction between the student and the videodisc system in the environment herein described.

RESULTS and CONCLUSIONS

Since this is a report on research in progress, at the time of this conference very little is known about the observation. The observation files have not gone through the transcription process of Program PLEXYN at this time. The only possible remarks regarding the observation that can be made is that the "novelty effect" is evident in that it produced excitement in some over the possibility of something different to do, and created anxiety in others because of the fear of the unfamiliar. This does not appear to say too much, but it must be realized that videodisc systems are a new technology, and nearly everywhere in education, and particularly at the elementary level this effect is going to be encountered for some time.

The minimal results currently available from a cursory examination and tabulation of responses to the interviews with students reveals no apparent differences between gender regarding attitudes and perceptions of videodisc systems. Most of the students, thirty-six of thirty-nine, or ninety-two percent claimed to be comfortable working with the videodisc system. An even higher percentage, thirty-eight of thirty-nine, or ninety-seven percent found the system "friendly." Thirty-two students, or eighty-two percent, thought the videodisc system was "smart" or "intelligent," while two thought otherwise, and four students were uncertain. Possibly the most divided response concerned whether or not a "conversation" or "dialogue" could be held with a videodisc system. Sixteen, or forty-two percent, thought this was a possibility, while eighteen, or forty-seven percent, did not think this was possible, three, or eight percent, put forth a tentative maybe, and one, or three percent, did not know.

Biographical information gained through these interviews indicated a high incidence of television viewing ranging on the average about two hours an evening, and slightly higher viewing times on the weekend, by the students' own estimates. Ten students, or twenty-six percent had personal computers at home, and an equal number owned video tape recorders.

Finally, while the results are not complete, the evidence is clear, at least to this researcher that in studying student interaction it is necessary to expand current educational research paradigms to include social interaction analysis.

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TITLE: PERSUASION: FIVE STUDIES DEALING WITH THE
RELATIONSHIPS BETWEEN MEDIA, ATTITUDES, AND
LEARNING STYLE

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PERSUASION: FIVE STUDIES DEALING WITH THE RELATIONSHIPS BETWEEN MEDIA, ATTITUDES AND LEARNING STYLE

Attitudes are predispositons to respond (Zimbardo and Ebbesen 1970). In other words, attitude helps shape subsequent behavior. Since attitudes are relatively stable and enduring, but still subject to persuasion, they are important to educators because many believe that they have some impact on learning.

Fleming and Levie (1978) make a convincing argument for why educators should be concerned with attitudes and their modification. First, it is apparent that educators do attempt to convince others of the importance of certain ideas, such as attitudes related to social issues like the treatment of minority groups. Attitudes also affect the way people attend to ideas and events. People pay attention to what they enjoy, and tend to ignore or misinterpret what they dislike. It is also likely that information is retained more easily when it is consistent with attitude positions, and is more difficult to remember when it is counter attitudinal. A final reason attitudes and their formation are important to educators is so that biasing messages can be identified and modified either during the design process or during instruction (Fleming and Levie, 1978).

As early as 1931, Thurstone was able to demonstrate the impact of a single filmed message on the attitudes of children. Using a pretest, posttest design, Thurstone found that children's attitudes toward China and Chinese culture could be modified either positively or negatively, depending on the intent of a motion picture they watched. Other researchers have found generally similar results. For example, Levonian (1963) used an audience assessment to tailor the content of a film about India. Attitudes of viewers of the motion picture were changed significantly.

Simonson (1979) summarized the results of over two hundred research studies that investigated attitude change and found the literature seemed to indicate that persuasive messages were often successful when instructional media such as films, videotapes, slides and filmstrips were used to deliver them. However, it was also reported by Simonson that media/Attitude research was somewhat suspect.

Several reasons were given for questioning the results of research on media and attitudes. First, the attitude construct investigated in many of the studies Simonson reviewed was often not clearly defined. As a dependent variable used to test hypotheses, the attitude topic was rarely explained as fully as were achievement variables. A second concern was the inadequacy of tests used to measure attitudinal outcomes. Over fifty percent of the time, Simonson found that there was no descriptive information reported about the measure of the attitude dependent variable. Finally, many of the studies used poor experimental designs. Often, attitude measurement did not seem to be the primary concern of the researcher. Rather, attitude testing was often a post-hoc analysis of peripheral importance to the main purposes and design of the study.

In spite of these problems, there seemed to be some common characteristics of successful persuasive instructional messages that if included in their planning, production, or utilization would contribute to attitude change. As a result of this review, Simonson (1984) proposed six guidelines for using instructional media to change attitudes.

Recently, however, a number of questions concerning the impact of instructional media have been made. One of the most interesting summaries of instructional media research was presented by Clark (1983). As a basic theme for this review, Clark stated "The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more that the truck that delivers our groceries causes changes in nutrition." (Clark, 1983, 445) Clark also stated that the results of reviews of media research published in the last several years seem to be unambiguous and unanimous in finding that any research results that reported a relationship between media and achievement were probably confounded. This confounding was usually caused by either instructional method or content differences between treatments, or a novelty effect for the newer media.

It is important to note that Clark reported on research summaries with achievement as the dependent variable. In other words, it seems to be Clark's opinion, based on literature reviews, that media do not influence achievement, and that one medium is not superior to another in producing more positive learning outcomes. However, Clark did not discuss attitudes. The results of media research summarized by Clark were not studies with persuasion as the primary goal. While it might be convenient to assume that similar conclusions could be made for the impact of mediated messages on a student's attitudes, or even psychomotor skills, the summaries of research reported by Clark do not satisfactorily document this position. As a matter of fact, there is some evidence that there is a hierarchy of preferred media types when attitudinal outcomes are of primary importance (Simonson, 1980; Wager, 1975), and that the media type used to deliver persuasive messages is related to the impact of those messages.

PURPOSE

The purpose of this paper will be to report the results of five studies that attempted to answer the following questions.

> 1. Is there a hierarchy of media types related to effectiveness at delivering persuasive messages? In other words, are media that are able to deliver messages realistically, as defined by Dale (1946), more effective than media that depict messages less realistically?
>
> 2. Is there a learner aptitude interaction with media type when attitude change is the goal of instruction. In other words, do the learner characteristics of Field Dependence/Field Independence, and Hemisphericity interact with media type when persuasive messages are delivered?
>
> 3. Is it necessary to design mediated messages differently for learners with different learning styles when persuasion is desired? In other words, are media uniformly effective for all learners, or are there different "best" designed media for different groupings of students?

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VARIABLES DEFINED:

The five studies reported below all examined the impact of persuasive messages. There were three media used in one or more of the studies to deliver treatments. They were motion pictures, videotape copies of motion pictures, or 2 x 2 color slide versions of motion pictures. There were two cognitive styles included as independent variables (Ausburn and Ausburn, 1978). They were Field Dependence/Independence, or Hemisphericity. The content of experimental treatments, and the focus of tests of dependent variables were either attitude toward soil conservation, attitude toward smoking, or attitude toward disabled persons.

INDEPENDENT VARIABLES DEFINED:

> FIELD DEPENDENCE/INDEPENDENCE(FD/FI): FD and FI are considered to be pervasive, stable cognitive styles that influence a person's perception of messages (McLeod et al., 1978). FD learners are those who are influenced more by their environment than are FI learners who are more influenced by internal forces. FD individuals seem to be more socially oriented, and are more affected by praise and criticism from their peers. FD tend to take a more passive, spectator role in learning than do FI learners (Farrell, 1971). FI learners, on the other hand, seem more adept at taking a message apart and at understanding its component parts. FI persons tend to be more active learners who often have a strong self concept.
>
> People are not totally Field Dependent or Independent. Rather, they have tendencies one way or the other. For the purposes of the studies reported below, the Group Embedded Figures Test (GEFT; Witkin et al., 1971) was used to identify a person's learning style. Subjects for study were given the GEFT in a standardized testing

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environment, then were categorized as being either FD or FI, depending on their score on the GEFT. Since this test provides a score from zero to eighteen, subjects were assigned randomly to treatments by ordering them from lowest score to highest and by using a table of random numbers to place them in treatment groups. Students who had scores within one score of the average of all scores were not included in treatments. They were excused from the experiments because the GEFT did not satisfactorily identify them as being either FD or FI (Witkin et al, 1971).

HEMISPHERICITY: Researchers have reported that in spite of a great deal of overlap of function, the two hemispheres of the brain organize and encode information to two different ways (Sperry, 1977; Bogan, 1976). Generally, the left hemisphere is more logical, convergent, and analytical. It is responsible for language and processes information sequentially. The right hemisphere is more holistic, intuitive, spatial, and divergent (Ornstein, 1977). The left hemisphere seems to perceive relationships across time, while the right hemisphere specializes in data that is significant across space (Nebes, 1977).

It has also been determined that individuals tend to have a dominant hemisphere. That is, one hemisphere tends to take priority when information is processed. It has been proposed that this hemispheric dominance is related to effective learning. In other words, how a person perceives data in part determines how much is learned.

In order to assign subjects to treatments, the Conjugate Lateral Eye Movement (CLEM) Test was used to identify a person's dominant hemisphere (Day, 1964). The CLEM is an individually administered test that requires observations of a subject's eye movement after reflective questions are asked of them. The movement of the eyes in this kind of a situation is related to hemispheric dominance. The CLEM Test has a reliability of .78 (r=.78; Baken and Strayer, 1973).

Subjects in Study #5 were tested using the CLEM and were assigned to treatment groups. Individuals who did not have a clearly dominant hemisphere as indicated by the CLEM were excused from the experiment.

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DEPENDENT VARIABLES:

Three dependent variables were used to examine research questions. Three studies were concerned with students' attitudes toward soil conservation. One study examined attitudes toward smoking, and one study investigated attitudes toward disabled persons.

1.The "Soil Conservation Attitude Test" (SCAT) was developed by Cook (1979), and revised by Kloock (1981). It contained twenty four statements that subjects reacted to using a five response likert-type scale. The SCAT was reported to have a reliability estimate of .85 (r=.85; Kloock, 1981)

2. The "Smoking Attitude Scale" (SAS) was a twenty-one item measure with a five response likert-type scale. The SAS had a reliability estimate of .85 (r=.85; Baer, 1966).

3. The "Attitudes Toward Disabled Persons" (ATDP) test was a twenty statement measure with a six level likert-type scale. The ATDP had a reliability estimate of .76 (r=.76; Yucker et al., 1970).

METHODOLOGY:

The design of each of the five studies will be discussed next. The specific utilization of the dependent and independent variable defined above will also be explained.

Study #1: In many respects, this study could be considered a pilot because treatments and the measure of the dependent variable were used experimentally for the first time. However, the experimental design, the treatments, and the measure of the dependent variable were considered to be of high enough quality to allow this study to be considered a rigorous one.

There were four treatments. Three were experimental and one was a control. The three experimental treatments were based on a twenty-three minute persuasive film titled, "We Are of the Soil". It was designed to introduce soil conservation practices such as conservation tillage to the audience, and to convince them that these practices were critical ones.

Subjects in the first treatment viewed this motion picture. Students in the second treatment watched a 2x2 slide with accompanying audio tape that was produced from the motion picture. Each scene in the film was analyzed and the key still picture was copied and made into a slide. The film's narration was copied onto an audio tape. When students viewed the slides they were projected using a dissolve unit and two carousel slide projectors.

Students in the third experimental treatment only listened to the motion picture's narration. They did not view anything, but sat in a darkened room.

This study used a pretest, posttest control group design (Campbell and Stanley, 1963; Design #4). Subjects were high school students in a medium sized city in the midwest. First, subjects were administered the SCAT to determine their attitude toward soil conservation, then subjects were randomly assigned to one of the three experimental treatments, or to the control group. Treatments were administered approximately one week after the pretest. After treatments were viewed, subjects were again administered the SCAT. The change in score from pretest to posttest for each student was combined with others and used to test hypotheses.

Subjects also rated the technical quality of the treatments. Ratings were high and generally equal. The group that only listened to the narration rated their experience the lowest (3.51 on a scale of 1-5 with 5 = excellent), but this rating was not significantly different than those of the other two experimental groups.

Study #2: This study was a modified replication of Study #1. There were several changes. First, the design was a post-test only control group (Campbell and Stanley, 1963; Design #6). Subjects, who in this study were college undergraduates, were randomly assigned to treatments. SCAT scores were compared to the control group in order to test hypotheses. The pre-test was omitted because it was felt this would minimize the influence of testing bias. Also, the audio only treatment was dropped from the experimental design. The three treatment groups were the group that watched the motion picture, the group that watched the slide with audio tape, and the control group. Additionally, the SCAT, the measure of the dependent variable, was modified slightly for this study based on the results of Study #1. Its reliability was .65 (r=.65).

The most significant change from Study #1 was the inclusion of the independent variable, Field Dependence/Independence. Subjects were given the GEFT (Witkin et al., 1971) before assignment to

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treatment groups. GEFT scores were rank ordered from lowest (a score of one) to highest (an eighteen). Subjects who obtained scores within one point of the mean of all scores were eliminated from the experiment because the GEFT did not satisfactorily categorize them as being either Field Dependent or Field Independent. Assignment of subjects to treatment groups was then completed by placing the subject with the lowest score in the film treatment, the next student in the slide with audiotape treatment and the next student in the control group. This procedure was followed until all subjects were assigned to one of the three treatments.

Study #3: This study was a modified replication of Study #2. There were three changes. First, the topic of the experimental treatments was changed. A film titled "The Right Approach" was selected by a jury of media specialists as an excellent persuasive film. Its topic was the employment of the handicapped. A slide with accompanying audio tape was produced from the key visual of each scene of the film in a manner similar to how the slide treatment was produced for Studies #1 and #2. These treatments were judged by experts to be of generally equal quality.

Naturally, since the topic of the treatments changed the test of the dependent variable had to be changed also. A standardized test of attitude toward disabled persons was found in the MENTAL MEASUREMENTS YEARBOOK (Buros, 1978). The "Attitudes Towards

Disabled Persons" (ATDP) test was used to measure attitude after treatments were administered. The ATDP was reported to have a reliability estimate of .76 (r=.76; Yucker, 1970)

The second change was to use fifth and sixth grade students as subjects. They ranged in age from ten to thirteen. Last, a follow up testing three weeks after treatments was given to a small sub-sample of subjects to determine if attitude changes produced by the treatments persisted.

Thus, the post test only design for this study had two independent variables, Field Dependence and Treatment. The 2 cell by 3 cell design had three treatments (motion picture, slide with audio tape, and control), and two levels of the cognitive style Field Dependence/Independence.

Study #4: This experiment could also be considered a modified replication of Study #2. There were two major changes made to the design of Study #2 for this experiment. First, junior and senior high school students were used as subjects. These students ranged in age from 13 to 18, and attended school in a small town in an agricultural state in the midwest.

The second change was the examination of the independent variable hemisphericity in this study to replace Field Dependence/Independence. Subjects were first tested using the Conjugate Lateral Eye Movement (CLEM) test to determine their dominant brain hemisphere. Then they were assigned to one of three treatment groups. The first treatment group viewed the persuasive film "We Are of the Soil". The second group watched the slide with accompanying audio tape version of this motion picture. The last group was a control. After treatments were completed, the SCAT was administered. This study used a two cell by three cell, post test only control group design.

Study #5: This experiment took a slightly different approach than the four Studies discussed above. At its foundation was the principle reported by Simonson (1984), and Rogers (1973), that use of fear may be an effective technique for attitude change especially if preventatives or probabilities of exposure to the fear provoking event are included in the message. In other words, an effective persuasive message that shows the dire consequences of not following some course of action, such as stopping smoking or wearing seat belts, can be made more effective if cures for the problem or techniques for how to change behavior are included in the message.

Study #5 used a two cell by three cell post test only control group design. Field Dependence/Independence was an independent variable, and the college students who participated in this experiment were tested using the GEFT and assigned to one of the three treatment groups just as they were in Study #2.

Experimental treatments were based on a film titled "The Feminine Mistake", a 23 minute long anti-smoking motion picture sponsored by the American Cancer Society. This film was selected by a group of media specialists from a number of others because of its high quality. Permission was obtained from the copyright holder to produce two fifteen minute videotape versions of the film. The first version showed only the fear provoking scenes included in "The Feminine Mistake". Narrated by Bonnie Franklin, star of the television program "One Day At A Time", this version showed scenes designed to scare viewers out of smoking. These scenes included an interview of a young woman undergoing chemotherapy for lung cancer, sequences showing how smoke deteriorates the tissues of the skin, and a presentation by a doctor of the results of medical tests that demonstrated the effects of cigarette smoke on unborn children.

The second fifteen minute videotape version included the most dramatic, fear provoking scenes used in the first version, but also included about five minutes of information on how to stop smoking. These scenes gave information on smoker's support groups, and how the body recovers once a smoker quits.

The two versions of the motion picture were evaluated several times during production. They were also evaluated by subjects during the experiment and in all cases were judged to be of generally high and equal quality.

After treatments were administered, subjects completed the Smoking Attitude Scale (SAS; Baer, 1966). The SAS was reported to have a reliability estimate of .84 (r=.84).

RESULTS: The results of each of the five studies will be presented in turn, then the implications of these results will be discussed.

Study #1: Descriptive statistics are reported in Table #1. While some changes in attitude occurred, there were no statistically significant results found. Of interest was the large dispersion of scores around the mean. In other words, the treatments did not influence students uniformly. Some students were affected considerably, and some were not influenced at all.

In retrospect, it was decided that the use of a pretest was probably not a good idea. Campbell and Stanley (1963) recommended the posttest only, control group design (Design #6) when random assignment of subjects to treatments was possible. Studies #2 - #5 used Design #6.

Table #1 Here

Study #2: Descriptive and inferential statistics for Study #2 are reported in Table #2. There was a statistically significant attitude difference reported that was attributable to the treatments. The average scores of students in all four experimental treatment cells were more positive towards the importance of soil conservation than were the scores of control subjects. A Duncan's test (Ferguson, 1971) was used to identify where significant differences occurred within the design, and it was found that the subjects in the motion picture treatment who were identified as being Field Independent had more positive attitudes than did subjects in any of the other five treatment groupings.

Table #2 Here

Study #3: Results of descriptive and inferential statistical tests are reported in Tables #3A, and #3B. There was a statistically significant difference in attitude attributable to treatments and to the learner cognitive style Field Dependence/Independence. After treatments the subjects who viewed the motion picture generally had more positive attitudes toward disabled persons than did subjects who watched the slide with audio presentation. Average attitude scores of subjects in one of the two experimental treatments were significantly more positive than were the average scores of control subjects.

Average scores of several treatment cells deserve note. First, control subjects who were Field Independent were generally more positive towards disabled persons than were Field Dependent control subjects. Next, three of the treatment cells (Film/FD, Film/FI, and Slide/FI) had approximately equal attitude scores, while the fourth treatment group, the Field Dependent students who viewed the slide presentation, had significantly less positive attitudes toward the disabled than did any of the other experimental groups. It appeared that there was an interaction between Field Dependence and Treatment.

This study added a dimension not included in the other experiments. Three weeks after treatments were administered, fifty nine of the subjects were randomly selected for retesting. The results of that retesting are reported in Table #3b. There were no significant differences found, even though the trends of scores were similar to those obtained from the original administration of the attitude test, ATDP. There seemed to be a regression to the mean effect taking place (Campbell and Stanley, 1963). It was also apparent that Field Independent subjects generally were more positive towards disabled persons than were Field Dependent subjects. Because such small numbers of subject were included in this retesting it is impossible to draw generalizable conclusions from the data. Certainly, additional research with full scale retesting of subjects is necessary.

Table 3A Here

Table 3B Here

Study #4: Results of tests to provide descriptive statistics are reported in Table #4. There were no statistically significant differences found, although the trends of the mean scores were interesting. Left brain dominant subjects were generally more positive than were right brain subjects in all treatment categories.

In order to examine the data more completely, an analysis of SCAT scores for subjects in grades 9 through 12 was conducted. While results were not significant, it was found that subjects in the higher grades who were in experimental treatments had more positive attitudes when their scores were compared to control subjects in the same grade. In other words, the difference between control group subjects' and experimental group subjects' attitude scores were greater in the higher grades than they were in the lower grades.

Table #4 Here

Study #5: Results of descriptive and inferential tests are reported in Table #5. It was found that both experimental treatments were successful at significantly influencing subjects' attitudes toward smoking. In other words, subjects in both versions of the videotaped adaptations of "The Feminine Mistake" had more negative attitudes towards smoking after viewing treatments than did control subjects.

While the scores obtained from subjects who viewed the two experimental treatments were not significantly different from one another, the trends of scores did support the assumption that fear provoking messages that also included remedies for the problem discussed in the message would be more persuasive than would be those that only presented unpleasant information. There was no statistical difference reported between the levels of the independent variable Field Dependence/Independence, nor was there a significant interaction between Field Dependence and Treatment.

DISCUSSION:

This discussion of the results of these five studies will be segmented into three parts. First, the three experimental questions proposed above about the relationship between attitude change, media, and learning style will be examined. Next, additional research needed in this area will be identified, and last, a summary of the significance of these studies will be presented.

Research Questions:

Earlier, three specific questions were posed that served as guides for design of the five studies. The relationship between the results of the five studies to these research questions will be discussed.

> Question #1. Is there a hierarchy of media types related to effectiveness at delivering persuasive instructional messages?

First, it must be stated that no experiment "proves" anything. Results must be interpreted in light of limitations of the design of the study. Even when the general structure of an experiment is replicated several times as was attempted here, it is important not to become overconfident that results are generalizable in all instances. Certainly, readers of this report must evaluate it with a healthy skepticism. However, it does seem obvious that media can be used to deliver persuasive messages, and it is also obvious, though to a lesser degree, that media that depict messages more realistically, such as motion pictures, are somewhat better at changing attitudes than are media that deliver messages less realistically.

The impact of realistic persuasive messages on attitude change has been studied by psychologists for over two decades. Reinforcement Theory is based on the assumption that realistic messages have more cues for the viewer, and thus, are more effective at persuading (Hovland, 1961). The results of these studies seem to support the assumptions of this theory. The persistence of change produced in learners because of participation in experimental treatments is less obvious and in need of additional scientific inquiry.

> #2. Is there a learner aptitude interaction with media type when attitude change is the goal of a message?

Based on the results of Studies #2 and #3, there seems to be a relationship between Field Independence and persuasive messages presented by film. While it may be that films are, in general, better than slide presentations at changing attitudes, this may be because Field Independent learners are influenced considerably more than are Field Dependent viewers. It also seems that for the attitude constructs investigated by these studies, Field Independent persons had more positive attitudes about them to begin with. Evidence for this generalization can only be inferred from the statistical results reported above. Certainly, more study is needed.

#3. Is it necessary to design mediated messages differently for learners with different learning styles when persuasion is desired?

Data related to this research question is the most difficult to infer from the information reported above. While it might be convenient to assume than motion pictures work better for all subjects generally, and best for Field Independent subjects specifically, as Studies #2 and #3 seem to indicate, and that Hemisphericity is not related to attitude change, as the results of Study #5 seems to indicate, these generalizations would be subject to justified skepticism. Other equally interesting, but conflicting interpretations might also be drawn from the data. For example, the results of Study #5 seem to indicate that left brain dominant teenagers tend to be more positive generally toward the need for soil conservation, and that they are influenced more by a slide presentation than they are by a motion picture. While this kind of conclusion might seem logical based on what is known about the sequential, logical manner that left brain dominant persons seem to favor when they process information, the results of Study #5 are not statistically significant and do not allow generalizations of this kind. As is often the case, experimental research presents as many questions as it answers.

Suggestions for Additional Research:

One often stated, and valid criticism of educational research is the failure of investigators to replicate the work of others. Certainly, Studies #2,#3,#4, and #5 should be replicated. Modified replications, those studies than imitate most but not all of the design parameters of a previous study, are needed also. For example, Study #3, an experiment that used attitude toward disabled persons as its dependent variable, could be replicated using other age groups, and possibly another learning style as an independent variable. Also, Study #5 could be replicated using a different age group, or with the same age group but with a different dependent variable. In other words, a mosaic of many studies dealing with the general research questions posed above are required before global generalizations are made.

Summary of Conclusions:

A fundamental assumption of the research presented above was that attitude change was an important concern of the educator. Since attitudes are predispositions to respond, and because some evidence is now being reported that relates attitudes to behaviors, the modification of attitudes was considered a worthwhile experimental endeavor. Most obvious by its omission from the five research designs discussed in this report was any examination of attitude position to related behavior. In other words, there was no study of subjects' actions after their attitudes were successfully modified. Did soil conservation improve? Did cigarette smoking decrease? Did interaction with disabled persons increase? While there is some evidence in the literature that the modification of attitudes will change subsequent behaviors (Simonson, 1977), these relationships require considerable more study.

It is also important not to overlook what does seem to be supported by the results of the five studies presented in this report. First, attitudes toward educationally relevant topics, such as conservation, smoking, and disabled persons, can be modified by using persuasive messages delivered by media. Next, it appears that some types of media may be more effective than others at delivering information designed to change attitudes. Motion pictures seem the most effective, possibly because the film medium presents information most realistically. There also seems to be sufficient evidence to warrant further investigation into the relationship between persuasive messages, media used to deliver those messages, and the learning styles of the target audience. Clark's comparison of media to delivery trucks may be safe and if not supportable, at least difficult to refute. However, it may not be totally accurate, especially when the products delivered are cartons of attitude rather than crates of achievement.

Table 1. Descriptive Statistics for Study #1

	TREATMENTS				
	Motion Picture	Slides with Audio	Audio Only	Control	TOTAL
N	40	49	43	43	175
$\bar{X}a$	+.37	+1.65	-.08	-.52	+.38
SD	9.31	8.34	8.29	8.73	8.65

$\bar{X}a$ = average change between pre- and post-test (higher positive number indicates positive change toward soil conservation)

Table 2. Descriptive and Inferential Statistics for Study #2

A. Descriptive statistics

	Treatment			
	Film	Slides	Control	Total
Field dependent subjects	$\overline{X}a$ = 64.69 N = 13 SD = 6.76	$\overline{X}$ = 65.33 N = 12 SD = 7.39	$\overline{X}$ = 61.14 N = 14 SD = 8.47	$\overline{X}$ = 63.62 N = 39 SD = 7.64
Field independent subjects	$\overline{X}$ = 69.86 N = 14 SD = 4.85	$\overline{X}$ = 65.31 N = 13 SD = 7.96	$\overline{X}$ = 63.69 N = 16 SD = 7.95	$\overline{X}$ = 66.19 N = 43 SD = 7.42
Total	$\overline{X}$ = 67.37 N = 27 SD = 6.31	$\overline{X}$ = 65.32 N = 25 SD = 7.53	$\overline{X}$ = 62.50 N = 30 SD = 8.16	$\overline{X}$ = 64.96 N = 82 SD = 7.59

B. Multiple analysis of variance

Source	SS	DF	NS	F	Sign. of F
Main effects	482.45	3	160.82	2.98	.04*
Treatment	347.30	2	173.65	3.22	.05*
Field dependence	140.80	1	140.79	2.61	.11
Interaction	87.37	2	43.69	.81	.45
Explained	569.82	5	113.96	2.11	.07
Residual	4097.05	76	53.94		
Total	4666.88	81	57.62		

*$p < .05$.

$\overline{X}a$ = Higher scores indicate a more positive attitude toward soil conservation.

Table 3A. Descriptive and Inferential Statistics for Study #3

A. Descriptive statistics

	Treatment			
	Film	Slides	Control	Total
Field dependent subjects	$\bar{X}a$ = 86.08	$\bar{X}$ = 75.25	$\bar{X}$ = 67.83	$\bar{X}$ = 76.64
	N = 25	N = 24	N = 23	N = 72
	SD = 14.61	SD = 18.96	SD = 21.29	SD = 19.65
Field independent subjects	$\bar{X}$ = 85.17	$\bar{X}$ = 87.24	$\bar{X}$ = 78.35	$\bar{X}$ = 83.50
	N = 24	N = 21	N = 23	N = 68
	SD = 17.01	SD = 14.55	SD = 16.38	SD = 16.28
Total	$\bar{X}$ = 85.63	$\bar{X}$ = 80.84	$\bar{X}$ = 73.09	$\bar{X}$ = 79.97
	N = 49	N = 45	N = 46	N = 140
	SD = 15.67	SD = 17.91	SD = 19.52	SD = 18.35

B. Multiple analysis of variance

Source	SS	DF	MS	F	Sign. of F
Main effects	5489.81	3	1829.94	6.11	.001*
Treatment	3843.53	2	1921.77	6.41	.02*
Field dependence	1704.87	1	1704.87	5.69	.002*
Interaction	1188.08	2	594.04	1.98	.14
Explained	6677.88	5	1335.58	4.46	.001*
Residual	40150.01	134	299.63		
Total	46827.89	139	336.89		

*$p < .05$.

$\bar{X}a$ = Higher scores indicate a more positive attitude toward disabled persons.

Table 3B. Retest Descriptive and Inferential Statistics for Study #3

A. Descriptive statistics

	Treatment			
	Film	Slides	Control	Total
Field dependent subjects	$\bar{X}_a = 82.00$	$\bar{X} = 71.25$	$\bar{X} = 74.45$	$\bar{X} = 75.96$
	N = 9	N = 8	N = 11	N = 28
	SD = 20.54	SD = 22.19	SD = 15.91	SD = 19.14
Field independent subjects	$\bar{X} = 78.00$	$\bar{X} = 89.00$	$\bar{X} = 86.60$	$\bar{X} = 84.68$
	N = 10	N = 11	N = 10	N = 31
	SD = 23.88	SD = 18.00	SD = 15.13	SD = 19.25
Total	$\bar{X} = 79.89$	$\bar{X} = 81.53$	$\bar{X} = 80.24$	$\bar{X} = 80.54$
	N = 19	N = 19	N = 21	N = 59
	SD = 21.84	SD = 21.27	SD = 16.38	SD = 19.53

B. Multiple analysis of variance

Source	SS	DF	MS	F	Sign. of F
Main effects	1130.49	3	376.83	1.01	0.40
Treatment	13.59	2	6.79	.018	0.98
Field dependence	1102.19	1	1102.19	2.95	0.09
Interaction	1205.52	2	602.76	1.61	0.21
Explained	2336.02	5	476.20	1.25	0.30
Residual	19790.63	53	373.41		
Total	22126.64	58	381.49		

$\bar{X}_a$ = Higher scores indicate a more positive attitude toward disabled persons.

Table 4. Descriptive Statistics for Study #4

TREATMENT

	Film	Slides	Controls	TOTAL
Right Brain	$\bar{X}a$=57.26	$\bar{X}$=57.47	$\bar{X}$=55.56	$\bar{X}$=56.81
Dominant	N=19	N=17	N=16	N=52
Learner	SD=8.26	SD=11.35	SD=9.80	SD=9.65
Left Brain	$\bar{X}$=59.78	$\bar{X}$=60.64	$\bar{X}$=57.29	$\bar{X}$=59.02
Dominant	N=18	N=14	N=21	N=53
Learners	SD=11.38	SD=7.58	SD=7.76	SD=9.02
Total	$\bar{X}$=58.49	$\bar{X}$=58.90	$\bar{X}$=56.54	$\bar{X}$=57.92
	N=37	N=31	N=37	N=105
	SD=9.84	SD=9.81	SD=8.54	SD=9.36

$\bar{X}a$ = Higher number indicates a more positive attitude toward soil conservation.

Table 5. Descriptive and Inferential Statistics for Study #5

A. Descriptive statistics

		Treatments		
		Fear alone	Fear with alleviation	Control
Field	$\bar{X}$ a	38.93[a]	41.23	47.50
dependent	SD	7.78	11.67	6.76
group	N	15	22	14
Field	$\bar{X}$	39.85	40.21	48.32
independent	SD	10.87	8.95	13.16
group	N	20	24	22

B. Multiple analysis of variance - treatment by level

Source	D.F.	SS	MS	F	P
Main effects	3	1562.56	520.85	4.810	0.003*
Treatment	2	1554.52	777.26	7.170	0.001*
Level	1	0.35	0.35	0.000	0.960
Interaction	2	24.50	12.25	0.133	0.890
Explained	5	1587.06	317.41	2.930	0.020
Total	116	13614.47			

$\bar{X}$a = Higher scores indicate a more positive attitude towards smoking.

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SUPPLANTATION VERSUS GENERATIVE MODELS:
IMPLICATIONS FOR DESIGNERS OF INSTRUCTIONAL TEXT

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SUPPLANTATION MODEL VERSUS GENERATIVE MODEL: IMPLICATIONS FOR DESIGNERS OF INSTRUCTIONAL TEXT

During the 1984 AERA conference in New Orleans, I attended a session ("Learner Aspects of Human Thinking") in which participants addressed the potential of training students to use metacognitive strategies. Some of the ideas expressed during that session suggest a line of contemplation and research that I want to briefly discuss with you today. This line of inquiry seems to be of particular value because it rather epitomizes the point to which the field of instructional technology appears to have evolved.

The presenters in the AERA session discussed the efficacy of teaching students strategic behaviors, such as cognitive monitoring, rehearsal, and self questioning. My attention was particularly drawn by one of the discussant's comments. Dr. Gagne' suggested that we consider an alternative to metacognitive training. This alternative is "building the strategies into the instructional materials rather than into the learners." Implicit in his response was the issue as to whether it is more efficient and effective to train students in metacognitive strategies or to include within instruction conventions and cues that preclude the need for strategy use.

This question interested me because it seems that instructional technologists opt for the approach of "building the strategies into the materials rather than into the learner quite often as we design, develop, and produce instructional materials. I do not think we have seriously investigated the pros and cons of operating under such a model. With the current willingness in our field to look inside the "black box" of cognitive processing (Bovy, 1981; Bruning, 1983; Winn, 1982) such an investigation appears to be timely.

In my discussion today, I am going to label the design alternative of "building the strategies into the materials" as a supplantation model for designing instruction (Ausburn & Ausburn, 1978). The model of "building the strategies into the learner" I will label as a generative model of design. These contrasting models of design represent the extremes of a continuum that illustrates the ratio of the amount of processing support provided by the instruction to the amount of cognitive elaboration required of the learner. There are advantages and disadvantages of each model and conditions under which each might be appropriate. Within this presentation I would like to do three things: a) describe the two models more completely, b) suggest a line of research investigating the conditions under which each model, or when compromises between the two models, might be appropriate, and c) relate all this to the philosophical questions that seem to be arising in our field.

In my discussion I will use examples from the design of instructional print. This is the medium which holds the greatest interest for me at the moment. However, I feel that the issues which we will examine extend beyond the qualities of any one medium.

Supplantation Model of Design

A supplantation model of design (Ausburn & Ausburn, 1978) "builds the strategies into the instructional materials rather than into the learner." An instructional designer operating under this model would seek to identify the information processing demands of a learning task and perform those transformations--to a greater or lesser extent--for the learners. When Ausburn and Ausburn spoke of the supplantation model of design, they added the condition that the supplantation in the instructional materials would perform only those information processing requirements for the learner that the learner is unable to supply for himself. I suspect that instructional designers, in an attempt to make instruction as unambiguous and efficient as possible for the learner, may supplant some processing that the learner may actually be able to supply for himself.

The term supplantation seems to have come from Salomon (1979) who used it when describing the role of a zoom TV production technique. Students in his study were to complete a task which required attention to particular visual cues. Salomon conjectured that zooming in on relevant portions of a visual field would supplant the processing requirement of selecting pertinent cues from a field of many visual stimuli. He found, in fact, that this zooming did improve task performance for learners with low cue attendance skills; however, such supplantation depressed the performance of high cue attenders. Other studies investigating the effects of supplantation have found that supplantation techiques can aid haptic learners in tasks requiring comparisons of visual images (Ausburn, 1975) and field dependent learners in a task requiring the disembedding of a visual stimulus from a complex field of visual stimuli (Konkiel, 1981).

Allow me to give some specific examples of the supplantation model of design from the field of instructional print design. When designing instructional print, whether intentionally or by convention, we use a number of techniques to supplant some of the processing requirements of the "reading to learn" task. In a very fundamental sense, the task requirements of processing instructional text might be described as a) perceiving and decoding graphemic symbols, b) directing attention to important portions of the text (selective perception), c) organizing the concepts presented in the text in a form that can allow for encoding new information into existing cognitive structures, and d) retrieving and maintaining in working memory new information plus relevant information from existing cognitive structures.

These text processing requirements can be partially supplanted through the use of text design conventions. For instance, in order to support the perception of graphic symbols, the text designer uses typography with the high visibility and layout that includes adequate leading and line length. Decoding is supported by the use of high frequency vocabulary (Glynn & Britton, 1984). The designer may direct the reader's attention to information that she considers to be pertinent to the learning task by including instructional objectives; by providing typographical cues such as bullets, boldface type, italics, or underlining; and by adding summaries, overviews, or prequestions. The text processing requirement involving development of an organizational scheme may be supplanted through the provision of headings, outlines, marginal notes, or formatting techniques such as information mapping (Horn, 1976) or discourse punctuation (Showstack, 1982). Text designers may aid learners to encode new information into their existing cognitive structures (to integrate new information with prior knowledge) through the use of advance organizers, adjunct questions, and analogies (Glynn & Britton, 1984). The need to establish retrieval cues for future recall may be somewhat supplanted by the provision of access structures such as headings, marginal notes, and outlines. Finally, the demands of maintaining much information in working memory may be somewhat ameliorated through the use of chunking, lists, diagrams, charts, and verbal summaries.

As text designers we incorporate many of these processing surrogates in our materials. I suspect this will continue to be the case. However, there are sufficient equivocal research findings regarding the efficacy of such conventions (for example, Christensen & Stordahl, 1953; Hartley, 1980; Holley, 1980; Klare, Shuford & Nichols, 1958; Marshall & Glock, 1975; Meyer, 1975; Smith, 1983) for us to investigate the conditions under which such conventions promote learning and when they may actually have deleterious effects. One hypothesis to account for these equivocal results is that, for some learners, in some learning tasks, and under some conditions, the provision of such embedded strategies may short-circuit (Salomon, 1979) the depth of processing required for the achievement of learning outcomes. Perhaps the inclusion of organization, emphasis, and retrieval cues not only fails to encourage the learner to make those elaborations (ties between prior and new learning) necessary for learning to occur, but also may actually inhibit the learner in doing these things. In the past few years, considerable attention has been given to the allegation that the supplantation of processing may actually be deleterious to learning (Bovy, 1981; Salomon, 1979; Wittrock, 1979).

Which brings us to an alternative model of design.

Generative Model of Learning

A contrasting design model can be derived from Wittrock's (1974) generative model of learning. The generative model predicts that the greatest learning will occur when students construct idiosycratic ties between the instructional stimulus and their current cognitive structures. A designer operating under this model might view as her responsibility the construction of instructional sequences that will stimulate (or allow) learners to generate their own idiosyncratic transformations of incoming information. Such instruction allows for active construction of meaning and is presumed to support the depth of processing needed for optimal learning.

There are at least two tactics available to the designer who is operating under the generative model. She may attempt to direct generation of cognitive elaborations (for example by suggesting that learners create their own summaries of an instructional passage), or she may simply refrain from supplying surrogates and allow for spontaneous use of a cognitive strategy that learners have already acquired (e.g., the creation of their own summaries, outlines, or notes).

A text designer who is following a generative model of design may either direct or allow readers' text processing through a number of devices. A designer may direct generative decoding by including adjunct questions that require students to attach meaning to graphic symbols. The instructional text may suggest the use of generative attention-directing techniques such as underlining, circling, boxing, labeling, or drawing arrows. Or the text designer may simply allow students to spontaneously generate such cues for themselves. Students may be prompted to utilize such organization strategies as outlining; developing headings, labels, or keywords; making marginal notes; or creating webs, networks, or pattern notes (Fields, 1982). Encoding may be facilitated through such generative processes as answering application-level adjunct questions, creating analogies, writing summaries, or developing illustrations. Readers may establish their own retrieval cues with the attention-directing strategies such as underlining, boxing, and labeling. Finally, students may devlop their own strategies to accommodate the limitations of memory by generating mnemonics, diagrams, and setting up retrieval schemes.

Verbal learning studies suggest that stimulus materials that require generation of elaborations rather than supplanting such processing may lead to superior learning. Students appear to comprehend and remember better when they are required to generate their own underlining (Rickards & August, 1975); drawings (Bull & Wittrock, 1973), headings (Doctorow, Wittrock, & Marks, 1978), organizers (Wittrock, 1974), and questions (Frase & Schwartz, 1975) rather than having these processing supports provided for them.

Research literature includes, however, those studies that do not find a superior effect of learner-generated elaborations. A study by Dee-Lucas and DiVesta (1980) indicated that learners who generated topic sentences, headings, or related sentences performed no better than, and in some cases not as well as, those learners who had these cues provided for them. Doctorow, Wittrock, and Marks (1978) found that a combination of text-supplied plus learner-generated elaborations were superior to either textual cues or learner elaborations alone in facilitating recall and comprehension.

Directions for Future Research

Of course it is not a question of which model--the supplantation or the generative--should be used by designers and developers. None of us would wish to design, much less attempt to learn from, instruction which contains no processing cues. At the same time, we have all heard students, particularly good students, grumbling about "predigested pap" or had the sense that something about our designs do not elicit maximum effort from our students. We need empirical data to help us identify the conditions which prescribe the balance between these two models.

The conditions that prescribe the selection of a design model go beyond the most commonly mentioned determining factor -- whether learners have the processing skills required of the task or not (Bovey, 198[illegible]). The conditions that define an optimal balance between the models may arise from the nature of the learner, the nature of the learning task, the nature of the instructional environment, and interactions of these variables. For example, investigations searching for this balance must go beyond examining learners' characteristics such as prior knowledge of content, available cognitive strategies, and general ability to such attributes as achievement motivation and personal learning objectives. For example, one can imagine instances when instruction designed under a supplantation model that provides the processing to aid learners to attain a specified goal, may be deleterious if a learner enters the instruction with other learning goals in mind.

When considering the variable of task characteristics, while we must continue investigations into the information processing requirements of an instructional task (an overwhelming responsibility in and of itself!), it is critical that we extend the learning tasks that we examine beyond the verbal information objectives that are common in the research literature. Particularly if the instructional medium is print, we may profit from an examination of the implications of the limitations of cognitive capacity. For example, when a learning task requires the processing of instructional text in order to learn the application of an unfamiliar scientific principle, might it not be advantageous to supplant some of the text processing requirements in order to allow learners more mental "working space" for dealing with the complex principle? Other task features which require study are the ambiguity, complexity, and novelty of the learning task.

The constraints of the instructional environment must also be considered when determining the balance between the generative and supplantation models. For instance, when the designer anticipates that learners will be under debilitating time contraints, a tendency toward the supplantation model may be entirely appropriate.

While investigating the interplay of the learner, task, and learning environment a determinents of the most appropriate balance between the two extremes in the design models, it is important that researchers utilize a number of dependent variables. We may profit from extending dependent variables to include measures of an efficiency/effectiveness ratio, levels of attention, fatigue or boredom reports, and long-term effects of both supplantation and generative models.

Conclusion

As the field of instructional technology matures, we seem to be moving beyond the unquestionably effective techniques of the neo-behaviorists: the manipulation of the instructional stimulus to produce the desired, observable learning outcome. Many of us are investigating ways to refine this approach in order to accommodate potent factors that we have not considered in the past. One of these factors is the learner. In addition to the general aptitudes and prior knowledge of the learner, we wish to examine the design implications of the idiosyncratic processing strategies, cognitive organizations, and intentions of the learner. Being in the business of producing effective and efficient instruction we are also concerned with the pragmatic question of the extent to which we can afford to accommodate (even recognize) these idiosyncracies. In this presentation I have suggested one scheme within which we may begin to investigate these issues: a search for the conditions which specify the optimal balance between the supplantation and generative models of instructional design.

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COMPUTER LITERACY AND EMPOWERED LEARNING : A THEORETICAL PERSPECTIVE

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Dictionary definitions of literacy generally incorporate the two dimensions of being able to read and write (i.e. communicate), and being knowledgeable or well-informed. These definitions, especially when applied to the notion of universal literacy, have been commonly translated as the minimal amount of knowledge and skills necessary for an individual to function effectively in modern society.

This dual conception of literacy as functional knowledge and (communication) skills has provided the parameters of the debate on computer literacy. In some cases definitions have stressed only one dimension. Computer literacy has been defined as either having (programming) skills, that is "the ability to do computing" (Luehrmann, 1981), or possessing knowledge of computers and/or their social impact (sometimes referred to as "computer awareness"). Other writers have criticized this dichotomy and suggested that both are necessary: "there are two (not just one) generally accepted definitions of literacy", namely "the ability to communicate" and "the state of being informed" (Anderson et al, 1981). These authors examined the literature on computer literacy and noted a continuum ranging from an emphasis on knowledge of programming to an awareness of applications and issues concerning the impact of computers on society. Subsequently they offered their "comprehensive view" in which:

> "computer literacy should be thought of as the knowledge and skills the average citizen needs to know (or do) about computers".

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Barger (1983) attempted to unite all perspectives by advocating knowledge of both how computers work ("structure and operation") and their impact on the individual and society ("applications and limitations"), as well as a minimal level of programming skills. His summary of computer literacy definitions illustrates that the debate has been focussed on what type of knowledge is necessary and what level, if any, of programming should be taught.

All these arguments and definitions, however, reflect a particular view of epistemology, pedagogy, the nature of communication, and the role of schooling in relation to the social order. Discussion about these underlying assumptions has been conspiciously absent from the literature on computer literacy. This paper is an attempt to rectify this situation by provoking such a discourse and offering an alternative view of these assumptions. The alternative perspective implies a markedly different conception of computer literacy.

The Dominant or Functional Paradigm

Defining computer literacy on the basis of developing a comprehensive list of performance-based objectives, as undertaken in a project of the Minnesota Educational Computing Consortium (Johnson et al, 1980), legitimatizes one kind of knowledge and skills: that which is discrete, factual and measurable "by explicit and public criteria" (Popkewitz et al, 1982). Burrell and Morgan (1979) have described two opposing views of knowledge. The first view, which is exemplified above, characterizes knowledge as objective, rational

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and truthful (i.e. something to be accepted). This form of knowledge is external to the individual and "capable of being transmitted in a tangible form" to receptive others.

This epistemology leads to a pedagogical perspective of the student as a deficit learner, with classroom instruction following a symbolic abstract or "information assimilation" (Coleman, 1976) learning process. Such a process emphasizes efficiency in mastering knowledge of the past. It relies heavily on students possessing the language skills for encoding abstractions and the ability to transfer symbolic learning into action (Cunningham, 1983). Coleman nominated this dependence on language as the critical problem with the information assimilation method, especially for "subordinate groups within the culture who may lack elaborated language codes" (Cunningham, 1983). Yet computer literacy codes are further removed in abstraction from concrete experiences and action than natural language. So the development of knowledge and skills for understanding and using computers demands a facility with the abstract symbolic mode of thinking.

Ambiguous or problematic knowledge and incidental learning receive no attention in this paradigm. But most significantly, as Freire has criticized, the possession of knowledge is separated from the act of creating knowledge (Mackie, 1981). Not only is the generation of knowledge ignored, but so is "the learning of skills and attitudes appropriate for creating knowledge" (Popkewitz et al, 1982).

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Objective or scientific knowledge and information assimilation learning are predicated solely upon the rhetorical form of communication. The essence of rhetorical communication is transmission of the writer's (or speaker's) structure of reality in a form that can be translated by the reader (or listener) into his/her own framework of reality. In other words, a sender has a message to convey to a receiver. Rhetoric to be communicated must be brought into the individual's consciousness and externalized: a process that implies a conscious control of one's understanding of reality. Computer literacy that involves communication via programming languages requires an even more precise control of one's thought processes.

The paradigms of knowledge, learning and communication discussed to this point share a functional or instrumental purpose. Rationales for computer literacy are highly congruent with the functionality orientation of these paradigms. For example, rationales have exposited the need:

-to improve the nation's economic productivity in the face of foreign competition and "to maintain our national defense" (Deringer & Molnar, 1982);

-for individuals to function "effectively within a given societal role", such as scientists, engineers, managers, students, etc. (Anderson, 1982); and

-for students "to function as contributing members of a modern technological society" (Barger, 1983).

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Furthermore, a computer literacy curriculum based on individuals' societal roles, or "the context in which they handle information", has been proposed (Seidel, 1982). The intention is that "some people need low level understanding (of computers) and others, e.g. students and engineers, need higher level understanding" (Anderson, 1982).

A computer literacy curriculum developed for such instrumental ends has an implicit political agenda, namely to maintain the existing social order and stratify the student population into workforce categories. Social control and cultural transmission, where culture is defined by those having power in society, have been described as a critical role of schools (Young,1971; Bowles & Gintis, 1976; Apple, 1979; Popkewitz, 1983). At the same time it should be recognized that schools are only one part of a larger framework of social structures that reproduce unequal (by class,gender, and race) social relations (Apple,1982). In the past "industrial states have found it prudent to shape the distribution of literacy to their own ends", and supported mass literacy after the industrial revolution to obtain "workers with a greater range of skills for operating the increasingly specialized machine of industrial society" (Marvin & Winther, 1983). Current conceptions of computer literacy maintain this traditional function of schooling.

The Alternative or Critical Paradigm

A second epistemology views knowledge as "more subjective, spiritual ... and essentially personal (in) nature" (Burrrell &

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Morgan, 1976). It recognizes the learner as an active participant in the production of meaning. Thus the possession and creation of knowledge are inexorably linked. The multiple construction of social realities is presumed with knowledge being socially constructed from interaction in interpretative communities and from negotiation between teacher and student (Esland, 1971; Belsey, 1980). This view of knowledge has been related historically to literacy: "every measure of literacy ever devised appeals to some criterion of success in interpreting messages, and success in interpreting messages will always be socially constructed rather than an objective category" (Marvin & Winther, 1983).

As social knowledge involves extracting meaning from experience, the pedagogical starting point is a learning process based on experience. Coleman (1976) has advocated an increased emphasis on experiential learning in schools, especially "for students who have limitations in the information assimilation method". At the same time he maintained that eventually students must develop the language skills to participate successfully in the traditional system (Cunningham, 1983). This perspective on experiential learning, however, retains the deficit view of the learner and the legitimation of only knowledge sanctioned by the dominant culture. In both respects it differs from approaches that emphasize social and cultural context.

Freire has stressed that "literacy cannot be viewed in isolation from its social context", which is the "glaring omission in most functional analyzes of literacy"(Mackie, 1981). He added

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that literacy "can serve either to liberate human beings or domesticate them". Interestingly, Barger (1983) acknowledged the relationship of computer literacy to social domination and oppression:

"If a technical elite is not to gain tyranny over the common person ... computer literacy will be essential to human autonomy in the future".

He naively assumed, however, that a "non-technical or low-technical understanding of what computers are and how they work", an understanding of computer applications and limitations, and a minimal level of programming ability "will probably be sufficient" to overcome this threat. This approach ignores the power relationships within society and the plight of students who do not belong to the dominant culture. And, as Marvin and Winther (1983) have pointed out, "the extent to which written literacy is already economically and socially stratified will strongly influence the distribution of computer literacy as well".

The alternative or critical perspective seeks to empower students of the working class or minority groups who are disadvantaged or oppressed. Instead of emphasizing their deficits as learners, it "assumes that problems for individual learners may have their source in the structures of society" (Cunningham, 1983). The approach initially concentrates on students' concrete experiences within their own social and cultural context. An analysis of these experiences is intended to lead to "a heightened social awareness and ability to examine critical issues", often termed "critical

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consciousness" (Cunningham, 1983). Two key features emerge from this approach. First, cognitive skills such as analytical and critical thinking evolve when developed in the context of the student's experiences and examing how power functions in the social system. Second, the development of critical consciousness (concerning social power) demystifies knowledge and schooling and empowers students with control over their own learning. Traditionally schooling delineates who has the knowledge, and what and how that knowledge is to be learned. The critical perspective transforms this situation so that the student holds the power over what and how he/she learns.

Finally, a second form of communication has an important role in the critical paradigms. In contrast to rhetorical communication, expressive communication involves the representation of a person's feelings or ideas in a form that has meaning to the same person. Here the transmitter is the intended primary recipient of the message. Our natural language is a vehicle for expressing and clarifying personal feelings and subjective accounts of reality. Expressive commmunication, using natural language in various forms (including prose, drama, and poetry) or music or painting or other artistic medium, enables us to be interpretive, critical, and even irrational. Computer languages require us to be procedural and scientifically rational - and admittedly enable us to be creative but within syntactical bounds. In other words the computer epitomizes only one kind of rationality, "scientism" or logical empiricism, and excludes kinesthetic, ethical, spiritual, and most aesthetic forms of thought and expression.

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Maxine Greene (1982) has eloquently connected the arts and literacy through the ability of works of art to continually provoke a search for meaning. Works of art, she argued, are generally inexhaustible - no matter how familiar they become - in eliciting interpretation, critical thinking, and reflection; and in providing opportunities to perceive and integrate multiple perspectives of reality. Owing to these characteristics one could add that they can help us confront ambiguity as well as remind us that reality is "the product of individual consciousness" (Burrell & Morgan, 1979). In turn confrontation with ambiguity and "irrational" perceptions of reality illustrate the significant dimensions of our world that we cannot control. Greene did not stop at the experiencing of art and literature but added: students must be encouraged "to express what they see and hear". Such expression, through whatever medium, liberates the individual by giving "public form to private awareness" and simultaneously thwarts both loneliness and powerlessness.

Greene's view of epistemology obviously has much in common with that of Freire. Although a concern for the cultural context of the learner is not shared, her notion of literacy also emphasizes empowered learning and thus unites the critical paradigms:

> "Teachers who conceive their students as some plastic material, or some sort of resistant medium, cannot think of empowering students to learn how to learn, to articulate, to be with one another".

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The Critical View of Computer Literacy

Several issues emerge in constructing a conception of computer literacy from the perspective of the critical paradigms outlined. First, as the work of Freire and Greene has indicated, the quest for consciousness and social knowledge or personal meaning involves critical reflection upon and analysis of experiences and actions. These experiences should take place within the context of the student's socio-cultural reality (Freire) or encounters with works of art or literature (Greene). Additionally for both authors, the "act of knowing" and "conscientization" comprises dialogue or expressive communication. Thus the first question must be: How can contextually meaningful experiences and actions with a computer help the student create and express personal meaning and critical consciousness? Second, the development and expression of critical consciousness is intended to liberate the student from domination or powerlessness in social relationships so that empowerment over his/her learning resilts. This suggests the second essential question: How can the student be empowered to learn in a dialogical relationship with a computer?

While it has been claimed that the computer can provide "a structured set of experiences" (Bork, 1980), these are simulated abstractions of real experiences that can be quantified or visually represented. It should also be remembered that the simulated experiences in instructional software tend not to relate to the everyday experiences of students of subordinate social or cultural groups. Similarly the manipulation of abstractions involved in

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programming requires a high level of language literacy that is often beyond such groups. If these two problems are overcome, then computer-based heuristic strategies, and heuristic languages such as LOGO, may help a student develop a schema for organizing meaningful knowledge and foster a divergent mode of critical thinking (in a performance sense). Computer heuristics, however, cannot create personal meaning or develop critical consciousness.

Perhaps then the second question provides some justification or hope for computer literacy. To Freire the essence of empowered learning is problem posing in which "students are required to examine, to know, and to transform their world, and thus participate in genuine communication" (Mackie, 1981). Posing problems, in these terms, is a semantically demanding activity. Problems posed for examination by computer necessitates their expression in a syntactical, symbolic and quantifiable form with the inherent danger that human problems become reified and divorced from their social and cultural context.

The only apparent solution compatible with the critical paradigms is to treat the computer as a cultural object for critical reflection. In this case the computer, including its social power, is posed as a problem, in an historical and cultural context, requiring cooperative investigation by students and teacher. Watt's (1982) idea of treating the school as a microcosm of society in which students investigate "changes occurring in the social organization of the school" from the introduction of computers could be employed as one part of this approach.

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Only a dialogical relationship between student and teacher can provide the semantic engagement and negogiation essential for the problematizing of one's existential situation and the construction of critical consciousness. The computer, as an increasingly significant part of many students' life experiences, does have a place in the curriculum as an object of inquiry in the continual construction of social knowledge. All other conceptions of computer literacy beyond this one risk assigning consciousness and autonomy to computers, in which case we surrender our uniqueness as human beings and our quest for the meaning of our existence (Weizenbaum, 1976).

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Children's Learning from Broadcast Television: The Relationship Between the Amount of Time a Child Watches Television With and Without Adults and that Child's Learning from Television

Susan Ruotsala Storm, Ph.D.

Paper presented at the Annual Meeting of the Association for Educational Communications and Technology, Anaheim, California, January 17-22, 1985

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CHILDREN'S LEARNING FROM BROADCAST TELEVISION: THE RELATIONSHIP BETWEEN THE AMOUNT OF TIME A CHILD WATCHES TELEVISION WITH AND WITHOUT ADULTS AND THAT CHILD'S LEARNING FROM TELEVISION

Susan Ruotsala Storm, Ph.D.

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ABSTRACT

The research was designed to determine young children's learning from selected television program content where the subject matter varies and to test for a relationship between that learning and the amount of time a child watches television with and without adults. It used a unique learning test developed from selected television segments using instructional design principles. A score was determined for each subject on each broadcast segment, as well as a total score. These were the dependent variables. The independent variables included: age, sex, level in school, television viewing hours with and without an adult, birth order, family composition, and education of parents. This study assumes that television learning tests can be developed; assessment can be made of what children learn from television; variables can be identified that account for the variance in scores on the television learning tests. Data for this study of 261 K-2 children were gathered using developed tests of learning for four broadcast television segments: a :30 Betty Crocker commercial, a 4:00 Batman segment, a 2:00 MIG-25 news story, and a 2:55 segment of Electric Company. In addition, a questionnaire was sent to parents/guardians of all subjects. Using Statistical Analysis System, the data were analyzed using frequencies, bivariate correlations, and multiple regression analysis. The best stepwise regression model using the learning score as the dependent variable is a four variable model. It accounts for 35% of the variance in learning test scores. Variables in the model include level/age which accounts for 27% of the variance in children's learning scores, achievement in school as ranked by teachers (3%), the average educational level of adults in a subjects' home (3%), and amount of viewing with adults (3.5%). An item analysis was run on all 28 items of the test by both grade and by grades combined. This study concludes that the amount of viewing that a child does with adults appears to make a difference in how well s/he understands what is viewed; that subjects in this study whose adults in the home had more education were reported to watch less television than others, usually had fewer siblings, did better in school, and learned more from the selected television programming, especially programming designed to teach content traditionally taught in elementary schools; that the amount of viewing, sex, birth order and family size do not appear to have any relationship to how much cognitively a child learns from television.

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Problem and Rationale

It has been suggested as a model of communication that at any point in time each person lives within a communication mosaic (see Becker cited in Mortensen, 1972). The mosaic communication model, unique for each individual, is composed of all the bits and pieces of information from various sources -- for example, television -- to which an individual is exposed. The communication mosaic is dynamic, changing with the individual's development, exposure patterns, attention levels, and world view. Two individuals seemingly exposed to the same bits of information are in fact probably perceiving very different realities because of other variables, such as cognitive style, competing sources of information, and context of the message. What may be an impressive bit of information for one individual may be of little consequence to another, depending upon the operating communication mosaic of each.

Television as a source of information need not be argued in the United States. The pervasiveness of this medium is supported by census data reporting the increasingly higher number of hours per day and week that increasingly more television sets are on. It is the rare individual for whom television does not play some part as an information source within his/her communication mosaic. Television is an information source and a learning

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source for all individuals.

Even outside the theoretical framework of the mosaic model of communication, researchers early established that children can learn from television (Lesser, 1972; Salomon et al., 1972; Meichenbaum & Turk, 1973; Raphael & Wagner, 1974; Henderson, Swanson, & Zimmerman, 1975; Children's Television Workshop, 1977). It can be said that learning occurs every single time a person views television. It does not have to be an "educational" television program to produce learning. All television is educational. The important question is not what sort of television is educational, but rather what is learned from any particular broadcast (Storm, 1976). This is consistent with the mosaic model of communication which would extend the question to what is learned by each individual given his/her background, age, and numerous other variables unique for each person.

Neither the importance of the developing individual, nor the importance of the overall context of exposure can be overlooked when researching learning from any medium. To study television in the context of the individual's communication mosaic at least two types of research are important: 1) content analyses of the medium, and 2) studies of learning from television that include descriptive information on individual children viewing television.

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This study was designed to explore young children's learning from selected television programs with attention to the viewing context and the child's family composition. No attempt was made to determine the beneficial or deleterious effects of television programs, but rather to measure learning where the subject matter varied, and to determine the relationship of other variables to that learning.

No hypotheses were formed for this study, but rather, questions about children's learning from television were asked. They included:

1) What relationship exists between the amount of time a child watches television with and without adults and that child's learning from television?

2) What relationship exists between school achievement, education of parents and learning from television?

3) What is the relationship between sex, family size, birth order, and learning from television?

Related Literature

It became apparent in the '70s that children definitely learn from television (Bandura, 1965; Gage, 1963; Salomon et al., 1972; Lesser, 1972; Meichenbaum & Turk, 1973; Henderson, Swanson, & Zimmerman, 1975); the concern turned to "what" they learn and how to approach measurement and evaluation of learning from television.

According to the theories of instructional technologists and social learning scholars, the question of what is

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learned from television can be approached by studying what is programmed for television. These theories have stimulated numerous content analyses, with sexism, racism, and violent behaviors most studied. Beale (1975) suggests the examination of intention through content analysis, but Adams & Schreibman (1978) argue that content analysis cannot replace audience research for answering questions about learning. Snow (1974) criticizes research on children's learning from television that fails to define situations in other than adult terms.

While learning occurs each time there is an exposure to television content, children may fail to learn what a particular producer intends due to poorly designed instruction/content. Friedlander (1975), for example, suggested that a student's failure to learn the producer intended cognitive content in certain public health films can be attributed to confusion between a film's audio and video messages. It should not be mistaken that no learning occurs. The learning that occurs is dependent upon the learning designed, intended or not -- labelled "educational" or not. The learning designed can be found by an analysis of the instruction/content using any one of several instructional design models (Storm, 1980). The concern, then, should be the content analysis from the perspective of the viewer of the content, rather than just the content itself.

With the exception of the Children's Television Workshop, most broadcasters rarely attempt to control cognitive or affective learning outcomes. Objectives of programs are often unrelated in an instructional design sense. This does not mean that cognitive and/or affective outcomes are not being produced. Early research on cognitive learning found that only younger, duller children actually gained knowledge from television (Himmelweit, Oppenheim, & Vince, 1958). Yet, the question must be asked about what 1950s television information/content had designed for cognitive learning. Also, what specific 1950s television content was used in the early studies. While certain genres exist, not all television is alike, anymore than all books are alike. Television is a medium only -- a channel for information/content; a medium constantly changing its content.

With the changing information/content of the medium and in the context of the mosaic model of communication, television's exposure environment becomes important in the measurement and evaluation of learning. An estimate of this context of exposure can be obtained from knowing the viewing patterns of the consumer: what programs an individual usually watches, who else watches the programs with that individual, what goes on during viewing, what after, etc. Leifer, Gordon and Graves (1974) suggest that the presence of a respected adult during program viewing can greatly influence a child's reaction to the content. This adult can be 1) controller and cultivator of program preference, 2) commentator during viewing and later acting-out behavior, and 3) discerner of reality. If what these researchers conjecture is true, adult viewers have the potential to determine the social effects of programming (see also Adler, 1978) as well as the cognitive outcomes of exposure. Heald (1980) recognized the potential influence parents have on children's viewing patterns by presenting parents with guidelines and recommendations for viewing with children.

While the potential effects of a respected adult viewing television with children is recognized, most researchers (McLeod, Atkin & Chaffee, 1972; Greenberg, Ericson & Vlahos, 1972; Thompson & Slater, 1983) found that the majority of parents do little more than place minor limits on their children's television viewing, if that. Abelman (1984) warns, however, that the parent-child interaction should not be ignored for the predispositions it might imply. Information might be collected from adults as to how much viewing is done with children, what form it takes and what levels of educational background the adults bring to the environment. Landes (1975), commenting on the linguistic environment, says that it is often taken for granted in research on speech acquisition. He states that ignoring the input of parents and environmental factors for innate ideas is unfortunate. He suggests that researchers specify the environment.

Research Methodology

Two hundred sixty-one kindergarten, first and second grade students were the subjects of this study. After pilot testing, 219 subjects were available to be tested for cognitive learning after viewing randomly selected broadcast television segments. Program content for this study was selected at random from a single weekday of network broadcasting. The first segment selected was a 0:30 commercial. The second selection was a 4:00 portion of Batman. A 2:00 news story on the Russian MIG-25 fighter plane seen on ABC was selected as the third type. The final selection was a 2:55 segment of the Electric Company.

An instructional development approach was used to construct a testing instrument for each broadcast television segment. The process included two major steps: 1) Identification of some potential learning outcomes for each segment, and 2) Development of test items based upon the potential learning outcomes. The final instrument contained twenty-eight items: one three-choice, twenty-three two choice, and four free-response items.

A questionnaire was also developed to gather data from a parent or guardian of each subject on : amount of viewing, composition of family, and long term context of exposure to television for each subject. Respondents were asked to assess the average amount of time their child watched television during the school week, Saturdays and Sundays. They were also to estimate the amount of time the child watched television with an adult during the school week, Saturdays and Sundays. One section of the questionnaire included questions on the composition of the family and the long term context of exposure for each subject.

Classroom teachers were asked to rank students in their classes according to academic achievement. Three categories were used in the ranking: high, medium and low.

Small groups of five or fewer subjects viewed each televised segment, with individual interview testing after each segment. A learning score was determined for each subject on each of the four segments, as well as a total learning score. These were the dependent variables. The independent variables included: age, sex, level in school, television viewing hours with and without an adult, birth order, family composition, and education of parents.

Using the Statistical Analysis System, the data were analyzed using frequencies, bivariate correlations, and stepwise multiple regression analysis. An item analysis was run on all 28 items of the test both by grade and by grades combined.

Results

The number of subjects included in each of the following analyses varies according to the values available for the various variables.

Achievement

Teachers classified 79 (or 36%) of the subjects as high achievers, 90 (41%) as medium achievers, and 47 (21%) as low achievers.

Learning Test

The learning test contained 28 questions in four segments, one for each of the televised slices. The mean score for segment one was 2.74; 6.38 for segment two; 3.75 for segment three; and, 6.49 for segment four. The learning test as a whole had a mean score of 19.26 (69%). A table of the learning test raw score means by grades and classrooms for each segment and the total test appears as Table 1.

Item Analysis of Learning Measurement Instrument

Item analyses were run by grade in school on all test questions used to measure learning from broadcast segments. The items for all grades generally discriminated positively and the distractors generally discriminated negatively. The mean test discriminations for all grades on all tests was equal to or above .22. The range in mean test discriminations was from .22 to .58. The mean test difficulty for all grades on all tests was equal to or above 49. The range in mean test difficulty was from 49.20 to 85.78.

Amount of Viewing

The children in the study watched a great deal of

Table 1

Raw Score Means for Learning Test Segments*

		Segments				
		1	2	3	4	Total
	Perfect Score:	5.0	9.0	5.0	9.0	28.0
K (85)	(24) room one (am)	2.46	5.79	3.96	5.54	16.92
	(18) room two (am)	2.50	5.77	3.66	5.11	15.67
	(23) room one (pm)	2.60	5.87	3.83	5.65	17.52
	(20) room two (pm)	2.80	5.1	3.95	5.05	15.85
	Total	2.59	5.63	3.85	5.34	16.49
1 (68)	(22) room one	2.68	6.55	3.95	7.18	19.86
	(24) room two	2.67	5.84	3.92	7.17	20.58
	(22) room three	2.50	7.14	3.27	7.05	19.96
	Total	2.62	6.51	3.71	7.13	20.13
2 (57)	(17) room one	3.35	7.53	3.76	7.70	22.35
	(19) room two	3.32	7.37	4.0	7.63	22.26
	(21) room three	3.19	7.19	3.76	7.90	22.05
	Total	3.29	7.36	3.84	7.74	22.22
(210)		2.74	6.38	3.75	6.49	19.26

*(1) commercial, (2) _Batman_, (3) news, and (4) _Electric Company_. All totals broken down by rooms and grade levels, kindergarten, first, and second.

television both with and without their parents. Table 2 displays the reported viewing hours of these subjects by week, day, average Saturdays and Sundays. The mean reported number of hours of television watched alone per day during the week is 3.40; on Saturdays, 4.58; on Sundays, 3.04. During the week it was reported that subjects watch an average of 2.47 hours with an adult; 2.61 hours with an adult on Saturdays; and 2.78 hours with an adult on Sundays.

Family Composition

Children in the study came largely from two-adult households. The mean number of adults per home was 2 with 173 of the subjects reporting two adults in the family home, 15 subjects with only one adult, and 12 with three adults. Eighty-four of the subjects were first-born with 52 second children, 30 third children, 18 fourth children, 6 fifth children, 4 sixth children, 2 seventh children, 1 ninth, 3 tenth, and 1 eleventh child. Subjects reported 68 with no brothers and 69 with no sisters. Eighty-eight had one brother and 30 had two. Eighty-seven had one sister, 25 had two, and 16 had three.

Parents of the children tended to be largely high school graduates. The highest reported educational degree was a master's degree (see Table 3).

Test Day, Test Group, Test Order

There was no significant relationship between test day, test group and test order and the scores on the learning tests.

Table 2

Absolute Frequencies and Mean Reported Viewing Hours Per Child Weekly*

No. of Hours	Hours Daily During the Week (alone)	Hours Daily During the Week (with adult)	Saturday Hours (alone)	Saturday Hours (with adult)	Sunday Hours (alone)	Sunday Hours (with adult)
0	0	8	2	22	5	10
1	3	38	3	33	26	31
2	44	73	12	52	52	58
3	67	36	38	31	52	43
4	52	26	43	31	32	31
5	16	9	38	14	15	13
6	11	5	36	10	11	6
7	3	1	10	1	3	3
8	0	1	13	3	4	4
Missing	23	22	24	22	19	20
Total	219	219	219	219	219	219
Mean	3.40	2.47	4.58	2.61	3.04	2.78

*Total mean hours of television viewing per week is equal to 42.36 hours.

Table 3

Absolute Frequencies for Highest Degree Obtained by Adults* in a Subject's Family

Highest Degree Obtained	Adult No. 1	Adult No. 2	Adult No. 3
None	6	21	
Grammar School	24	28	1
High School	138	124	11
Community College	20	20	1
College--BA	6	6	
College--BS	5	2	
Master's	2		
Missing Cases	14	14	202
Total	215	215	215

*Adults defined as persons over 18 years of age living in the home.

Bivariate Correlations

Level in School

There was a highly significant relationship between learning in this study and the level, or grade, in school with r = .54, $p < .05$. Table 1 displays the raw score means for learning by grade level. There is an almost six point spread between kindergarteners and second graders. The largest differences were in test scores for segments two -- Batman -- and four -- Electric Company. Grade level does not appear to be related to any of the remaining variables in the study except, of course, age.

Age

A significant relationship between learning in this study and a subject's age was found with r = .49, $p < .05$. Neither age nor grade level was significantly related to learning from the news segment. "Age" is related to none of the other variables in the study except, as indicated above, level in school.

Achievement in School

Achievement in school, as assessed by the classroom teachers, was found to be related to the total learning score with r = .17, $p < .05$. Achievement in school was not related to an individual's score on any of the first three segments of the learning test: the commercial, Batman or the news. An individual's score was related on the fourth segment, Electric Company, $r = .17$, $p < .05$, to school achievement. Achievement was found to be negatively related to the total hours a subject watched television ($r = -.25$, $p < .05$), the amount of time a subject watched television with an adult ($r = -.21$, $p < .05$), the number of hours a child watched television alone on Saturdays ($r = -.26$, $p < .05$), the number of hours a child watched television on Saturdays with an adult ($r = -.23$, $p < .05$), the number of hours a subject reported watching television alone on Sundays ($r = -.24$, $p < .05$), and the number of hours a subject reported watching television on Sundays with an adult ($r = -.19$, $p < .05$). Children ranked by teachers as high achievers tended to report watching less television either with or without adults.

Educational Level of Adults in Subject's Home

The relationship between the learning score from the television material in this study and the average educational level of the adults in the subject's home was significant at the .05 level with $r = .14$.

The adults' average educational level and the total number of hours a subject watched television weekly were negatively related with $r = -.20$, $p < .05$. The adults' educational level was negatively related to family size ($r = -.17$, $p < .05$), age of subject ($r = -.17$, $p < .05$) Saturday television hours a subject watched alone ($r = -.15$, $p < .05$), Saturday hours a subject watched with an adult

($r = -.25$, $p < .05$), the number of Sunday hours a subject watched alone ($r = -.20$, $p < .05$), and the number of Sunday hours a subject watched with an adult ($r = -.23$). A significant positive relationship was found between the adult's average educational level and the subject's achievement in school with $r = -0.16$, $p < .05$.*

Significant correlations were not found to exist between the learning score and the amount of viewing, birth order, family composition (as defined only by the number of adults and siblings), or sex.

All of the segment scores are reasonably well correlated .30 to .57 except for the learning scores for news which are not significantly correlated with the learning scores for any of the other segments (see Table 4).

Stepwise Multiple Regression Analysis

Regressions were run in a stepwise fashion using the statistical analysis system. The computer selected the order for entry of significant variables into the model.

The best stepwise regression model using the learning score as the dependent variable is a four variable model. It appears as Table 5. This model accounts for 35% of

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*A negative r here is the result of the way in which data were gathered and coded: higher numbers meant more education for the variable adults' average educational level; lower numbers meant higher achievement in school for that variable.

Table 4

Summary of Correlations between Age, Level in School, Achievement in School, Education of Adults, and the Four Segments and Total Learning Scores

	Commercial	*Batman*	News	*Electric Company*	Total
Age	.24	.44	.05	.46	.49
Level	.28	.47	.07	.51	.54
Achievement	.08	.12	.06	.17	.17
Average Education of Adults	.11	.09	.04	.13	.14
Commercial	1.00	.30	.10	.43	.62
Batman	.30	1.00	.03	.57	.80
News	.10	.03	1.00	.05	.27
Electric Company	.43	.57	.05	1.00	.87
Learning Total	.62	.80	.27	.87	1.00

*The four segments included: the commercial segment, the *Batman* segment, the news segment, and the *Electric Company* segment. Correlations are significant with r greater than .14 at the .05 level.

Table 5

Best Stepwise Regression Model Using Total Learning Score as Dependent Variable; Four Variable Model

	DF	Mean Square	F	Prob > F
Regression	4	302.93	25.57	.0001
Error	186	11.85		
Total	190			

	B Value	Standard Error	Type II Sum of Squares	F	Prob > F
Intercept	16.10				
Achievement	-1.31	0.35	169.61	14.32	.0002
TV with Adult	0.13	0.06	50.08	4.23	.0412
Adult Education	.96	0.36	84.24	7.11	.0083
Level/Age	2.89	0.31	1047.63	88.42	.0001

R Square = 0.35

the variance in learning test scores. Variables in the model include level/age which accounts for 27%, achievement, 3%, the education of adults in the subject's home, 3%, and a subject's television viewing with adults for 3.5% of the variance in scores.

Stepwise regressions were run using the individual segment test scores as dependent variables. Three regression models were found: Betty Crocker learning test score with level/age, education of adults in subject's home, and achievement; Batman test score with level/age, amount of viewing a subject was reported as watching with adults, and achievement; and Electric Company test score with level/age, education of adults in subject's home, amount of viewing a subject was reported as watching with adults, individual viewing, and achievement. These appear as Tables 6, 7, 8, respectively. The models account for 10% of the variance in the Betty Crocker commercial segment test scores, 20% of the variance in the Batman segment test scores, and 33% of the variance in the Electric Company segment test scores. No combinations were found that accounted for a significant amount of the variance in the news test scores.

Discussion and Conclusions

This research was designed to investigate young children's learning from selected television program content where the subject matter varies and to test for relationships between that learning and a number of inde-

Table 6

Best Stepwise Regression Model Using Betty Crocker Commercial Segment Score as Dependent Variable; Three Variable Model

	DF	Mean Square	F	Prob > F
Regression	3	8.17	7.46	0.0001
Error	187	1.09		
Total	190			

	B Value	Standard Error	Type II Sum of Squares	F	Prob > F
Intercept	2.29				
Achievement	-0.18	0.10	3.27	2.99	0.09
Adult Education	0.21	0.10	4.63	4.22	0.04
Level/Age	0.38	0.09	18.66	17.02	0.0001

R Square = 0.10

Table 7

Best Stepwise Regression Model Using Batman Segment Score as Dependent Variable; Three Variable Model

	DF	Mean Square	F	Prob > F
Regression	3	42.48	15.44	0.0001
Error	187	2.75		
Total	190			

	B Value	Standard Error	Type II Sum of Squares	F	Prob > F
Intercept	5.85				
Achievement	-0.40	0.16	16.13	5.86	0.0164
With Adult	0.05	0.03	7.41	2.69	0.1024
Level/Age	0.94	0.14	112.84	41.02	0.0001

R Square = 0.20

81Da

Table 8

Best Stepwise Regression Model Using Electric Company
Segment Score as Dependent Variable;
Four Variable Model

	DF	Mean Square	F	Prob >F
Regression	5	61.59	18.12	0.0001
Error	185	3.39		
Total	190			

	B Value	Standard Error	Type II Sum of Squares	F	Prob>F
Intercept	5.01				
Achievement	-0.63	0.18	39.46	11.61	0.0008
Amount of Viewing	-0.05	0.05	4.70	1.38	.2410
With Adult	0.11	0.05	18.96	5.58	0.0192
Adult Education	0.53	0.19	25.90	7.62	0.0064
Level/Age	1.43	0.16	257.21	75.67	0.0001

R Square = 0.33

pendent variables. It used a learning measurement instrument developed from the selected television segments using principles of instructional design. For the purposes of analysis the test items were assigned correct and incorrect responses based upon the central story line and cognitive content.

The dependent variable was learning from the television material. The independent variables included: age, level in school, school achievement, education of the adults in the family, sex, television viewing hours with and without an adult, birth order, and family composition.

The study was designed to explore a number of questions:

1) What relationship exists between the amount of time a child watches television with and without adults and that child's learning from television?

The amount of viewing that a child does with adults appears to make a difference in how well s/he understands what is viewed.

In this study, parents reported how much television their child watched on a daily, Saturday, and Sunday basis, with and without them. Only eight adults reported that their children watch no television during the week with an adult. Quality of the time adults spend viewing with children was not measured. Many adults watching with children make no comment at all during viewing, while others offer a running commentary. It has been suggested that learning from any medium can be enhanced by verbal supplements that point out and/or reinforce a particular message. Verbal supplements can also distract. More likely learning of specific television material is dependent upon comprehension of other television viewed with or without adults. Comprehension is probably a result of a child's age and his/her learned ability to learn from any medium.

This study took the suggestions of several researchers (Leifer, Gordon & Graves, 1974; Adler, 1978; Heald, 1980) that the presence of a respected adult during program viewing can greatly influence a child's reaction to content and measured the amount of with-adult viewing done by subjects to see if it would account for any of the variance in scores on a learning test from selected broadcast segments. This study found that previous viewing with adults was related to a subject's learning test score and accounted for 3.5% of the variance in scores.

Although nothing conclusive can be said from this one study about subjects viewing with adults, other than the fact that a lot of it goes on, there is some indication that adult viewing and what goes on during joint viewing slightly improves children's ability to learn from television.

2) What relationship exists between school achievement,

education of parents and learning from television?

Subjects in this study whose adults in the home had more education were reported to watch less television than others, usually had fewer siblings, did better in school, and learned more from the selected television programming, especially programming designed to teach content traditionally taught in elementary schools.

A significant negative relationship was found in this study between the adults' level of education and the amount of television a child was reported to watch. The higher the educational level of adults, the less television s/he reported a child tended to watch. This may mean that the more educated an adult, the more s/he controls the television viewing of offspring. According to the adults in their homes, the average young child in this study watched about 3.39 hours of television per day without adults during the school week. (See Table 2 for raw data of reported viewing.) This brings up an interesting point about reported data. If children are watching without adults present, how do those adults estimate that viewing time? Also, would adults tend to report higher or lower figures depending upon how they wished to appear to the researcher? I suspect some may have as, after all, they were told that their child would participate in a study on television and the questionnaire free responses had a generally positive attitude towards television. The more educated the parents, however, the fewer hours of television they report their children viewing. Television diaries might have been a better measure, although these are reports also. Subjects in the study whose parents had more education had fewer siblings, possibly because families were delayed while parents were in school. This is also consistent with established relationships between amount of education and family size.

The amount of television a subject was reported as watching was also negatively related to school achievement as ranked by the teachers. Because the school had no standardized testing program, teacher rankings were used. The validity of these could be questioned. Although as an estimate of a subject's class ranking, the teacher report of school achievement is usable. This study supports the earlier work of Thompson (1964) who found a tendency for heavy viewers to be less intelligent and to do poorly in school. This should not be thought of as necessarily a causal relationship. While this study found that negative relationship between amount of viewing reported and school achievement, it also found a negative relationship between amount of viewing reported and the educational level of adults in a subject's home. The implication then that more educated adults just do not allow their children to watch and do not watch themselves as much television as less educated parents. More educated parents in this study had children who ranked higher in school achievement. In this study the amount of viewing was in no way related to subjects' performance on the television learning test. This study found no evidence to conclude that the amount of viewing negatively affected learning.

Both the educational level of adults in a subject's home and the child's achievement level in school were significantly related to the learning score. It would seem that parents with more education tend to monitor their children's viewing, have children that do better in school, and are reported watching fewer hours of television.

There is some, although not overwhelming, evidence from this study that children who learn well in school, learn well from television. The relationship between a child's school achievement and his/her learning score from the Electric Company segment was significant. A significant relationship was not found between school achievement and the learning scores on the other three segments. Electric Company, of the four segments, being most like school, tended to be understood best by those who apparently best understood school material. If there had been a relationship between school achievement and learning from the cognitive content of the news story as well as the cognitive content of Electric Company, then it could have been said that achievement in school is related to learning cognitive content from television for this study. However, from this study it can be concluded only that the learning of certain types of broadcast television material usually taught in schools is probably related to school achievement.

3) What is the relationship between sex, family size, birth order, and learning from television?

Sex, birth order and family size do not appear to have any relationship to how much a child learned from television segments in this study on a limited test (28 items) of cognitive content.

This study's failure to find a relationship between family composition and learning from television programming should not be interpreted as meaning that the family has no effect. The family structure and birth order and its impact on a child's ability to learn should be studied as Zajonc (1977) suggests. This study did not follow Zajonc's confluency model for intellignece and birth order effects. No conclusions about birth order can be drawn from this study.

A strength of this study is that it demonstrated a procedure for measuring learning from television material. Using instructional development principles, a reliable measurement instrument for television learning was developed. This instrument was subjected to peer review, review by other instructional designers and teachers, and was pilot tested. An item analysis was also run after collection of the data to assess the difficulty and discrimination of the test items.

This study concludes that the amount of viewing that a child does with adults appears to make a difference in how well s/he understands what is viewed; that subjects in this study whose adults in the home had more education were reported to watch less television than others, usually had fewer siblings, did better in school, and learned more from the selected television programming, especially programming designed to teach content traditionally taught in elementary schools; that the amount of viewing, sex, birth order and family size do not appear to have any relationship to how much cognitively a child learns from television.

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Notetaking Activity as a
Logical Classroom Learning Strategy

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Notetaking As a Learning Strategy

The most prevelant learning strategy used among college level learners is the external learning strategy of notetaking. An external learning strategy is defined as one involving an external behavioral activity such as: writing paraphrased ideas, developing hypothesis, developing an illustration of a concept, the verbatim writing of the presentation, or underlining. While an external strategy involves overt behavior, an internal learning strategy involves the covert mental manipulation of instructional information. A commonly used internal strategy to aid learning is the mnemonic memory device (Bower, 1973). A number of internal learning strategies involving covert mental manipulation, such as imagery mnemonics, have been investigated (O'Neil, 1978; Rohwer, 1970; Dansereau, 1979; Bugelski, 1970; Paivio, 1970), indicating that internal strategies can improve learning. While both external and internal types of learning strategies can be effective, in aiding learning, the external strategy of notetaking is the most extensively used by college learners. A recent survey involving over 800 undergraduate engineering students, representing a variety of engineering disciplines, revealed that notetaking is the primary method of abstracting information during class for later study (Canelos, 1983). This result also seems to apply to notetaking activities during the study of text material and other types of printed instructional materials. Additionally, undergraduates seem to be sensitive regarding attempts at changing their notetaking behaviors, if such attempts are made to improve notetaking efficiency. This would indicate that undergraduate students are conscientious about notetaking, and therefore consider notetaking strategies vital to their learning. For example, after using an innovative teaching strategy, aimed at improving notetaking during lectures, Kilareski, Canelos, and Reinschmidt (1982) found that students had strong attitudes regarding the new notetaking strategy.

While the notetaking strategy appears to be extensively used by learners, little is actually known about what types of notetaking strategies are better for acquiring specific types of intellectual skills such as: factual learning, conceptual learning, rule application, and problem solving. Furthermore, past research does not yield a great deal of information regarding how notetaking is operationally contributing to the learning process from a cognitive processing perspective (Ganske, 1981). The present study attempts to address this problem by operationally defining a notetaking strategy as a method of separating relevant to-be-learned material from background information given in instruction. This separation of relevant material for a specific intellectual skill, from irrelevant material seems to be the key information processing function of the notetaking activity. Hartley and Davies (1976) indicated three functional activities involved in notetaking:

1. identify and discriminate elements;
2. identify and discriminate the relationships of those elements;
3. identify how information is organized (Hartley and Davies, Note 1, p. 27).

The first two of these activities involve the behavior of separating what is relevant, and must be learned, from what is background information in the lesson.

The notetaking strategy used in the present study was called the directed overt activity strategy (DOA). The DOA notetaking strategy aided the learner in separating relevant information that had to be learned from irrelevant information. Learning performance using the DOA strategy was evaluated on three types of intellectual tasks: spatial learning, simple concept learning, complex concept learning. The performance of subjects using the DOA notetaking strategy was compared to subjects using their own covert internal learning strategy, while learning from printed instructional materials. The printed instructional materials consisted of a workbook providing information about the human heart. The printed information in the booklet was complemented with drawings of the heart. There were two types of booklets. The printed information was identical in both booklet types, in terms of content and organization. However, one booklet contained an illustration type drawing, and the other a line drawing. The instructional content in the booklets was designed to teach the names of the parts of the heart, and how the parts interact during heart operation, and the blood flow sequence during heart operation.

Experimental Design and Procedures

The experimental design of this study was a 2x2x3 analysis of variance, having two between-subjects variables and one within-subjects variable. The first between-subjects variable was type of notetaking strategy: directed overt activity strategy (DOA) and the covert activity strategy (CA). The second between-subjects variable was type of instructional booklet: line drawing instructional booklet and illustration instructional booklet. The within-subjects variable was type of intellectual task: spatial learning task, simple concept learning task, and complex concept learning task. The intellectual tasks were measured by three separate tests: identification test, terminology test, and comprehension test.

The first level of the notetaking strategy variable was the DOA notetaking strategy. Subjects in this condition were trained on how to use the DOA strategy in a 10-minute training period prior to receiving the instructional treatments. The purpose of the DOA strategy was to improve the learner's ability to abstract relevant information from the instructional booklet, for later performance on the three intellectual tasks. The key to the DOA strategy was to get the learner to actively respond to the information in the printed instructional materials. To accomplish this, the DOA strategy required the learner to respond on a notetaking sheet while reading through the instructional booklet. The notetaking sheet consisted of an 8x11 sheet with a drawing of the heart centered and filling up about two thirds of the sheet. The drawing of the heart was a blown-up version of exactly what was found in the instructional booklet except, of course, no labels, arrows, or text was provided. There were two types of notetaking sheets: an illustration sheet for those subjects using the illustration drawing booklet, and a line drawing sheet for those subjects using the line drawing booklet. In addition to active responding, the notetaking sheet provided the necessary structure for helping the learner concentrate on the to-be-learned information in the instructional booklet.

The learner was instructed to use the notetaking sheet in the following way. First, while reading through the instructional booklet, when a heart part name and location was described the name was to be written on the notetaking sheet near the correct location. Secondly, an arrow was to be drawn indicating the exact spatial location of the part. Thirdly, the instructional booklet described the interaction of the parts during heart operation, this information was relevant and should be learned. The learner was instructed to draw a double-headed arrow indicating the set of two or three parts of the heart that interact during a specific heart operation. For example, the superior and inferior vena cava fills up the right auricle, forcing open the tricuspid valve. Thus an arrow would be drawn from the superior and inferior vena cava through the right auricle to the tricuspid valve. This procedure would be done while reading the instructional booklet until all the interacting parts were identified. Finally, it was important for the learner to understand the blood flow. So the subject was instructed to draw a dotted line through the major portions of the heart to indicate blood flow. The second level of the notetaking strategy variable was the covert activity strategy (CA). The CA strategy required the subject to read through the instructional booklet and attempt to process as much information as possible from the instructional booklet. The CA strategy allowed the learner to use his or her own information processing or learning strategy that is typically used during academic learning. Since many college level learners have developed learning strategies on their own, it is likely that these innate strategies could be as effective as a learning strategy imposed during the instructional situation.

The second between-subjects variable was the type of instructional booklet used during learning. There were two levels of the instructional booklet variable: line drawing booklet, and illustration drawing booklet. A variety of visual types are used to complement printed instructional materials, it is is likely that visual complexity could effect learning and the overall effectiveness of the DOA strategy or CA strategy.

The within-subjects variable was type of intellectual task. The spatial learning task was tested by the identification test. The identification test was a 20-item multiple choice test designed to test the spatial learning of heart part location. The test contained an illustration drawing of the heart with numbers where each part was located. The 20 items appeared under the numbered drawing and were all worded in the following manner:

Arrow number 4 points to the
a. pulmonary vein
b. pulmonary artery
c. aorta
d. tricuspid valve
e. mitral valve

The spatial learning intellectual task was considered the easier of the three tasks. The simple concept learning task was tested by the terminology test. The terminology test was a 20 item multiple choice test. Each item gave a critical attribute about a heart part or operation and the subject had to identify the part or operation. The items on the terminology test were worded in the following manner:

The tissue which protects the
inside lining of the pericardium
is called the ________________.
a. extoxin
b. epicardium
c. endocardium
d. myocardium
e. ectocardium

The simple concept learning task was considered of intermediate difficulty, between the spatial learning task and complex concept learning task. The complex concept learning task was tested by the 20-item comprehension test. Each item on the comprehension test was designed to test the learner's knowledge of how the parts interact during heart functioning. The items on the test involve the interaction of two, three, or more simpler concepts about the heart, thus the name complex concept learning. The comprehension test is considered the most difficult of the three, and items on this test were worded in the following manner:

When impure blood is entering the
superior vena cave, it is also
entering the:
a. pulmonary veins
b. aortic arch
c. inferior vena cava
d. pulmonary artery

Subjects for the study were freshman psychology students from Ohio State University. Subjects participated in the study on a voluntary basis and received credit toward their final grade in their basic psychology course for participation. One hundred subjects signed up for the study. All subjects were given a pretest on human physiology and no subject had a score in excess of 35% correct on the pretest. Subjects were randomly distributed to type of instructional booklet, with 50 subjects in each of the two groups; illustration drawing booklet and line drawing booklet. From there, subjects were randomly distributed to type of notetaking strategy; DOA or CA. In each of the two groups of instructional booklet, 25 subjects used the DOA strategy, and 25 subjects used the CA strategy. Four separate classrooms were used so that each group of 25 subjects had no way of knowing what was going on with the other groups. Subjects in the DOA groups were given training on how to use the DOA strategy during the first 10 minutes of their session. A set of instructions was read to the DOA groups on how to use the strategy, so each of the two groups received identical instruction. The instructional booklets and notetaking sheets were then administered and subjects had 25 minutes to study the booklets while using the DOA strategy. At the end of the 25 minute study period, all instructional booklets and notetaking sheets were collected and the test battery of three tests was administered. Subjects were given 45 minutes to complete the test battery. Subjects in the CA strategy were told to use their normal study strategy when studying the instructional booklet. This was explained as the typical study strategy they use when in a lecture or studying textbook material on their own. The CA subjects were then given 25 minutes to study the instructional booklet. At the end of the 25 minute period, all instructional booklets and any written notes were collected by the experimenters. The test battery was then administered, subjects were given 45 minutes to complete the test battery.

Results

The resulting analysis of variance appears in Table 1. Statistically significant results failed to occur on the two between-subjects variables of strategy and instructional booklet and their interaction. This indicated that the visual type difference of line drawing or illustration did not effect learning and had no effect on strategy type used. However, there was a significant interaction between intellectual task and strategy, which could account for the lack of statistical difference between the overall DOA mean and CA mean. The within-subjects variable of intellectual task yielded a statistically significant F-ratio ($F(2,192\ Df) = 64.701$, $p<.0001$). A Tukey follow-up test set at a significance level of .01 was conducted to find the mean differences between the spatial task, the simple concept task, and the complex concept task. The spatial task mean ($\bar{x} = 14.06$) differed significantly from the simple concept task mean ($\bar{x} = 11.56$) and the complex concept task mean ($\bar{x} = 10.65$). The simple concept mean did not differ significantly from the complex concept task mean. This result indicated that the spatial task was in fact the easier of the three intellectual tasks. While the difference between the simple concept task mean was not statistically different, the complex concept mean ($\bar{x} = 10.65$) was lower than the simple concept mean of ($\bar{x} = 11.56$) indicting that the complex concept task was slightly more difficult.

The interaction between the strategy variable and intellectual task variable resulted in a significant F-ratio ($F(2,192\ Df) = 15.523$, $p<.04$). The means involved in the significant interaction appear in Table 2. The significant interaction is graphically displayed in Figure 1. A Tukey follow-up test, with a significance level of .05, was conducted on the resulting means to locate the source of the interaction. Looking at the DOA strategy level finds a statistical difference between the spatial task mean ($\bar{x} = 13.9$) and both the simple concept task mean ($\bar{x} = 11.16$) and the complex concept task mean ($\bar{x} = 11.02$). However, the simple concept task mean ($\bar{x} = 11.16$) and complex concept task mean ($\bar{x} = 11.02$) did not differ statistically. Looking at the CA strategy finds the source of the interaction. Similar to the DOA level, at the CA level the spatial task mean ($\bar{x} = 14.22$) differs significantly from both the simple concept task mean ($\bar{x} = 11.96$), and the complex concept task mean ($\bar{x} = 10.28$). However, unlike the DOA level, at the CA level there is a statistical difference between the simple concept mean ($\bar{x} = 11.96$) and the complex concept mean ($\bar{x} = 10.28$). The source of the interaction is this difference between the simple concept mean and complex concept mean at the CA strategy level.

This result indicates that as intellectual task difficulty increased subjects using the DOA strategy had an information processing advantage over subjects in the CA group using their own innate strategy. Subjects using their own strategy in the CA group performed quite well on the spatial learning task and simple concept learning task. However, the DOA group was able to abstract and retain more information from the instructional booklet about how the parts of the heart interact during the hearts operation than the CA group. While both groups performed well at the less difficult side of the intellectual task scale, the DOA strategy allowed subjects to identify important information to help them perform on the more difficult intellectual task.

Conclusions and Further Research

The directed overt activity notetaking strategy addressed three key elements that facilitated the cognitive processing of information. First, the use of the notetaking sheet provided a structure for the learner to help effectively organize new to-be-learned information. As Hartley and Davies (1976) indicated, this organizing principle is a significant aspect of learning via notetaking. Secondly, the DOA strategy directed the learner to identify relevant information from the instructional booklets that would be needed to successfully perform on the three intellectual tasks. Thus the learner is not left to his or her own decision making, as is often the case, on identifying what should be learned and what will be needed for test performance. Finally, the DOA strategy forces the learner to be intellectually active during the study phase of learning. The learner is not passively reading or passively taking notes, but must be active intellectually to complete the notetaking sheet while interacting with the instructional materials. The CA strategy and DOA strategy probably did not differ on the less difficult intellectual tasks because the CA group's own study strategies were relatively effective. Keep in mind here that the subjects were all beginning college level students who must have developed reasonably effective study strategies for this level of academic development. It is likely that high school and technical school students may benefit more from such imposed strategies. However as intellectual task difficulty increased, even slightly, the DOA strategy group significantly outperformed the CA group.

Of course, in this study the notetaking sheet, intellectual tasks, and printed instructional materials, were matched on a one-to-one basis, however the basic elements involved in the DOA strategy could be used for almost any type of print or lecture instructional materials. This would require the instructor to develop some type of notetaking sheets or handout packs for each lecture. The notetaking sheets would provide the organization or structure needed to effectively interact with the lecture. Of course, learners would have to be given instructions on how to interact with the notetaking sheets and the lecture. Finally, it would be necessary to organize the lecture quite well, and pace the lecture so students can follow along and continue to respond on their notetaking sheets. This type of notetaking strategy, to aid the learner in acquiring information during the lecture, has been tried at Penn State Engineering in a Civil Engineering course (Kilareski, Canelos, Reinschmidt, 1982). In this Civil Engineering course, a supplementary text was developed that consisted of a series of notetaking sheets for each lecture. These notetaking sheets required the learner to write in definitions, complete equations, solve simple problems, solve complex problems, and complete diagrams, during the 50-minute lecture. Some of these activities were simple "fill in the blank" type of tasks; others required complex problem solving. However, the key here is that the notetaking sheets kept learners intellectually active during the lecture, provided a structure, and identified important material that should be learned. Both students and faculty responded quite well to the Civil Engineering course notetaking methodology.

A similar notetaking approach was developed for an Engineering Science and Mechanics course at Penn State Engineering (Pytel, 1984). In this course, the notetaking sheets were designed to complement television instructional materials. They were referred to as Lecture Notes and were developed into a workbook format. The purpose of the Lecture Notes workbook, in the Engineering Science and Mechanics course, was to insure that students would be active while viewing the television lessons. Similar to the Civil Engineering methodology, the Lecture Notes required students to write in definitions, complete equations, develop illustrations and diagrams, and solve simple problems. In the Engineering Science and Mechanics course, students responded quite favorably to the Lecture Notes, and the method does improve learning from the Engineering Science and Mechanics television instructional materials.

These two applied examples of the use of a DOA type of notetaking strategy further confirms the positive effects upon learning of a notetaking strategy designed to: keep students intellectually active during the instructional sequence, point out relevant to-be-learned material, and provide a structure or organizing principle. Further studies in this area should consider the effects of similar notetaking strategies when learning from different presentation modes such as lecture methods, video based instruction, and computer based instruction. Additionally, since it is likely that high school and technical school students would benefit from learning notetaking strategies, such strategies should be further refined and tested using such students as subjects. Most high school level students have not yet developed learning and notetaking strategies that are effective and efficient. Further, primary level students and junior high level students would also benefit greatly from learning effective notetaking strategies if they were available. It has always been an amazing paradox that so much is known about learning strategies, of an external and internal nature, but few students are ever given formal instruction on these "learning how to learn" methodologies. Perhaps further applied research would tend to correct this serious pedagogical problem.

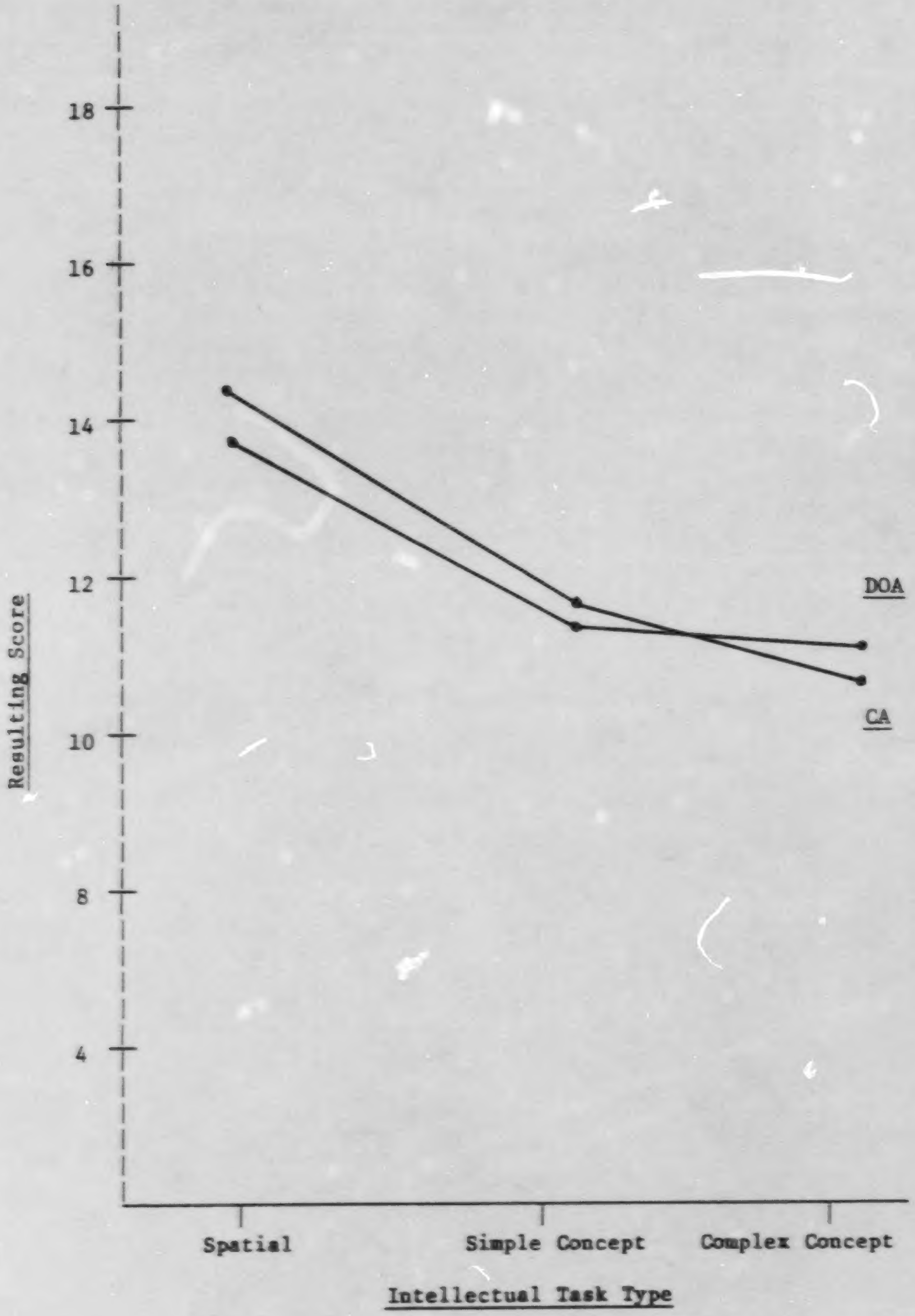

Figure 1: Resulting Disordinal Interaction.

Table 1: Resulting Analysis of Variance.

Source	Mean Squares	Df	f-Ratio	Probability
Strategy (A)	1.203	1	0.029	.86
Booklet (B)	76.003	1	1.823	.18
(A) x (B)	42.563	1	1.021	.31
error	41.681	96	—	
Intellectual Task (C)	311.770	2	64.701	.0001
(A) x (C)	15.523	2	3.222	.042
(B) x (C)	4.263	2	0.885	.41
(A) x (B) x (C)	3.523	2	0.731	.48
error	4.819	192	—	

Table 2: Strategy by Intellectual Task Interaction Table of Means

	Spatial Task	Simple Concept Task	Complex Concept Task
DOA	13.90	11.16	11.02
CA	14.22	11.96	10.28

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THE DEVELOPMENT
OF A
COMPUTER LITERACY ASSESSMENT INSTRUMENT

BY

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Statement of the Problem

Educators have recently been faced with the task of meeting the demands of society to educate students so that they become computer literate. In 1983, the "Nation at Risk" report of the National Commission on Excellence in Education recommended that computer science be required of all secondary school students (National Commission on Excellence in Education, 1983). An extensive review of the literature revealed that many public school districts were developing computer literacy programs and expecting students to become computer literate. In addition, many higher educational institutions had instigated computer literacy requirements for graduation. However, there were no known standards for determining what aspects of computer literacy should be taught at various levels of education, and no effective means of measuring the level of computer literacy possessed at various levels of education. A standardized measure of computer literacy was needed to facilitate the development of computer literacy courses that were appropriate to the needs of the students. Such an instrument would be critical for providing students with instruction and experiences suited to their level of computer literacy.

Purpose of the Study

The purpose of this study was to construct a valid and reliable criterion-referenced instrument to assess the computer literacy (knowledge, skills, attitudes) of students. Three primary purposes for the Standardized Test of Computer Literacy (STCL) were identified.

1. To document the computing competencies of students and to collect normative data about various subgroups of students.
2. To justify revisions in the content of computing courses to reflect student needs.

3. To provide criteria for the placement of students in appropriate computing courses based on their level of computer literacy.

Methodology

The procedures followed in the development of the STCL were designed to contribute positively to the overall validity and reliability of the instrument. A twelve step model for the development and validation of criterion-referenced tests was used as a guide for the development of the STCL. The methodology included the following steps (Hambleton, 1980):

1. Preparation and/or selection of objectives.
2. Preparation of test domain specifications.
3. Writing test items "matched" to objectives.
4. Preliminary review of test items.
5. Determination of content validity of the test items.
    a. Involvement of content specialists.
    b. Collection and analysis of examinee response data.
6. Additional editing of test items.
7. Test assembly.
8. Setting standards for interpreting examinee test performance.
9. Test administrations to criterion groups.
10. Assessment of test score reliability and validity; compilation of test score norms.
11. Preparation of a user's manual and a technical manual.
12. Periodic collection of additional technical information.

The first step in the development of the STCL involved defining the domain of content (computer literacy) to be measured by the instrument and identifying appropriate computer literacy objectives or competencies. A review of the literature was conducted to determine a definition of computer literacy, identify computer literacy competencies, and identify any existing test items or instruments measuring computer literacy. The following definition was adopted:

> Computer literacy is operationally defined as an understanding of computer characteristics, capabilities, and applications, as well as an ability to implement this knowledge in the skillful, productive use of computer applications suitable to individual roles in society. The knowledge and skills of computer literacy as defined above have been divided into four major categories; computer attitudes, computer systems, computer applications, and computer programming. These four sections are defined below.

1. Computer Attitudes refer to an individual's feelings about the personal and societal use of computers in appropriate ways. Positive attitudes include an anxiety free willingness or desire to use the computer, confidence in one's abilities to use the computer, and computer responsibility.

2. Computer Systems refer to the appropriate, knowledgeable use of equipment (hardware) and programs (software) necessary for computer applications. This requires understanding and abilities in the following areas: computer functions, computer hardware, computer software, computer systems configuration, computer terminology, historical development, and the operation of computers.

3. Computer Applications refer to the ability to responsibly evaluate, select, and implement a variety of practical computer applications to do meaningful and efficient work based on an understanding of the following: general types of applications, capabilities and limitations of applications, societal impact (past, present, and future), evaluation and selection techniques, and specific applications (word processing, data base management, spreadsheet/financial management, statistical analysis, graphics, and educational applications).

4. Computer Programming refers to the ability to direct the operation of the computer through the skillful use of programming languages (high level as well as software languages). This requires an understanding of problem solving strategies, algorithms and flowcharts, languages, and programming skills.

Next, computer literacy competencies were collected from a variety of sources, such as computer literacy course outlines, curriculum guides, textbooks, and computer literacy research studies reported in the literature. "The Computer Literacy Objectives", developed as part of the Computer Literacy Study conducted by the Minnesota Educational Computing Consortium (Klassen et al., 1980), were reviewed and accepted for the initial list of computer literacy competencies.

An attempt was made to ensure a more comprehensive and valid list of competencies for the STCL domain specifications. A survey was sent to 327 computer education specialists. Each computer specialist was asked to read the purpose of the STCL and the operational definition of computer literacy, and then write two computer literacy competencies for each of the four sections of the definition. The computer specialists were selected from the following sources:

1. The participants of the National Computer Literacy Goals for 1985 Conference (Seidel, Anderson, and Hunter, 1982).
2. The presenters at the National Educational Computing Conference of 1982 (Smith and Moum, 1982).
3. Computer Consultants listed in the 1983 Classroom Computer News Directory of Educational Computing Resources, Part III: Local and Regional Resources (Kelman, 1983).
4. The members of the International Council for Computers in Education, listed in the April 1983 issue of The Computing Teacher (Moursund, 1983).
5. Names of instructors derived from a listing of colleges and universities offering summer school computer courses in the March 1982 issue of The Computing Teacher (Moursund, 1982).

The list of computer literacy competencies obtained from approximately 90 computer specialists who responded to the survey was then combined with the list of competencies identified from the literature. A tally of each discreet competency was made by counting the number of individuals who mentioned each competency. The entire list of competencies was then reviewed by the STCL steering committee. A total of 87 competencies were selected for inclusion in the STCL domain specifications based on the following criteria (Klein and Kosecoff, 1973): transferability within the domain, widely accepted by content specialists, terminality, transferability outside the domain, and ease of scorability. The competencies were then categorized into the four sections of the definition (nine for computer attitudes, 24 for computer systems, 33 for computer applications, and 21 for computer programming).

The review of the literature revealed three valid and reliable computer-related instruments that were reviewed for possible inclusion in the STCL. "The Minnesota Computer Literacy and Awareness Assessment" (Klassen et al., 1980), The Computer Anxiety Index (CAIN) (Maurer, 1983), and the Beliefs About Computers Scale (BACS) (Ellsworth and Bowman, 1982) were reviewed to determine if any portions of the instruments were consistent with the computer literacy definition and competencies for the STCL.

It was the opinion of the steering committee that "The Minnesota Computer Literacy and Awareness Assessment" did not contain test items that were appropriate for the STCL. Most of the items on the Minnesota instrument were knowledge or comprehension level questions. One of the goals identified by the STCL steering committee was to develop an instrument that included test items that measured high level cognitive skills as identified by Bloom's Taxonomy of Educational Objectives (Bloom, Englehart, Hill, and Krathwohl, 1956). An attempt was made to develop an instrument that measured high level computer literacy skills, such as application, analysis, synthesis, and evaluation skills. The Minnesota instrument seemed to measure only knowledge and awareness aspects of computer literacy as defined for the STCL. The STCL steering committee concluded that higher level items could be written to measure computer-related skills.

The CAIN (Maurer, 1983) and the BACS (Ellsworth and Bowman, 1982) were considered to be appropriate for the computer attitudes section of the STCL. Both of these instruments consisted of Likert-type items and were shown to be valid and reliable measures of students' attitudes and anxiety towards computers. The CAIN is a twenty-six item scale with a test/retest reliability of 0.90 and an internal consistency reliability estimate of 0.94 (Maurer, 1983). The BACS is a seventeen item scale with a test/retest reliability of 0.85 and an internal consistency reliability of 0.77 (Ellsworth and Bowman, 1982).

Domain specifications for the STCL were developed based on the suggestions proposed by Popham (1980) and others (Berk, 1980; Millman, 1974; Hively et al., 1968). The Domain specifications contained a description of the purpose of the instrument, the definition of computer literacy, the list of competencies, guidelines for writing effective multiple choice items, and sample items.

The STCL domain specifications were distributed to a team of fifteen computer literacy specialists in the department of Professional Studies in Education at Iowa State University. Each specialist was asked to write multiple choice questions for ten or eleven of the competencies in the Computer Systems, Computer Applications, and Computer Programming sections of the STCL. Two questions were written for each competency in the three sections mentioned above. This produced a total of 186 test questions. The test item writers were encouraged to incorporate diagrams, illustrations, and other creative devices into appropriate questions to ensure a variety of test items at all levels of Bloom's Taxonomy of Educational Objectives (Bloom et al., 1956).

The 186 test items written by the computer specialists were reviewed, edited, and revised by the principal researcher. The entire collection of items was then divided into two sets, each containing approximately 90 questions related to the competencies plus fourteen items involving demographic information. The test items were then pilot tested to collect data for an empirical item analysis so that revisions could be made to improve the content validity of the items.

The two sets of test items were each administered to two criterion groups as recommended by Berk (1980): an instructed group of students and an uninstructed group of students. The instructed group consisted of forty-four subjects: forty-one college students enrolled in two educational computing courses and three computing instructors in the College of Education at Iowa State University. The students in these courses were considered instructed in computer literacy because a course titled Introduction to Computer Applications was a prerequisite to each course. The uninstructed group consisted of thirty-five students in education courses who had not taken a computer literacy course previously. Students in these courses who reported that they had taken a computer course were not included in the data analysis.

The data from each set of items, each section of the test, and each criterion group were analyzed by obtaining the following statistics: means, variances, standard deviations, item difficulty indices, item discrimination indices, and the frequencies of students responding to each distractor on each item. These statistics were carefully analyzed to identify items that needed to be revised or discarded to improve the content validity of the test.

In addition to the empirical item analysis, a judgmental item analysis was conducted by a panel of nine computer specialists at Iowa State University. The computer specialists were asked to examine each item and its respective competencies and make a judgment about the item-competency congruence and the technical quality of each item. A rating scale like one proposed by Rovinelli and Hambleton (1976) was used to rate how well each item measured the competency it was intended to measure (1-poor, 2-fair, 3-average, 4-good, 5-excellent). The mean ratings for all of the judges were calculated as an indication of the degree of item-competency congruence for each item. The higher the number, the more congruent the item-competency match. The judges were also asked to rate the technical quality of the item by indicating whether they felt the item should be rejected (1), accepted with revisions (2), or accepted as it was (3).

Berk's (1980) guidelines for the selection of items for a criterion-referenced instrument were considered in the decision to retain, revise, or reject each item. The criteria for acceptable items are summarized in the following manner:

Item characteristic	Criterion	Index value
Item-competency congruence	Matches objective measured	mean rating (3.00-5.00)
Difficulty	Difficult for uninstructed group. Easy for instructed group.	0-50 (uninstructed) 50-100 (instructed)

Item characteristic	Criterion	Index value
Discrimination (DIS_{uigd})	Discriminates between instructed and uninstructed criterion groups	positive index (10-100)
Discrimination (item-score correlation)	Discriminates within each criterion group	positive index (.10-1.00)

As a result of the empirical and judgmental item analyses, a total of eighty items were selected for the three sections of the STCL: twenty-four for computer systems, twenty-eight for computer applications, and twenty-three for computer programming. To ensure that the items included in the final test were representative of the domain of computer literacy, items were selected so that each competency was measured by the test. As the test items were being analyzed, it became apparent that some of the competencies needed to be revised to more accurately reflect the actual competencies measured by the test. Competencies that expressed the same basic skills were combined into one competency, and competencies that expressed more than one skill were separated into discrete competencies. The final list of computer literacy competencies contained eighty competencies: twenty-five in computer systems, twenty-five in computer applications, twenty-one in computer programming, and nine in computer attitudes.

The completed version of the STCL was divided into five sections: Background Information, Computer Attitudes (CAIN and BACS), Computer Systems, Computer Applications, and Computer Programming. The instrument was designed so that it could be administered as a whole or by section.

The STCL was administered to two groups of subjects, instructed and uninstructed students, in order to determine performance standards, demonstrate the test's validity and reliability, and to determine normative data. The CAIN was not administered at this time because validity, reliability, and normative data had been collected by Maurer in 1983.

The instructed group of subjects consisted of 152 college students who had received instruction consistent with the computer literacy competencies in a course titled Introduction to Computer Applications. The uninstructed group of subjects consisted of 110 college students who had not taken a computer course based on the computer literacy competencies.

Following the administration of the test to the two criterion groups, performance standards, or cut-off scores, for the total STCL and each of its subtests were determined by the method proposed by Berk (1976). This method, which is similar to the Contrasting-Groups Method (Hambleton, 1980), involved the identification of the point of intersection of the frequency distribution curves for the uninstructed and instructed groups.

The test score corresponding to the point of intersection for each section of the test was then evaluated by the principal researcher and the steering committee to determine whether it was a reasonable and appropriate criterion for classifying students as masters and nonmasters of computer literacy. If the performance standard identified with this method was not considered appropriate, a standard was set based on the judgment of the steering committee.

Internal consistency reliability coefficients for the total STCL, each section, and each criterion group were estimated using the Kuder-Richardson 20 reliability formula (Ebel, 1972). Internal consistency reliability for the BACS was estimated with coefficient alpha (Cronbach, 1970). Since the instrument has characteristics of both norm-referenced and criterion-referenced tests, a reliability of greater than 0.70 was considered an acceptable reliability coefficient (Iowa State University Test and Evaluation Services, 1983).

Construct validity for the total STCL and each of its sections was determined by calculating the amount of difference between the mean score of the instructed and the uninstructed groups. The means for the instructed group should be significantly higher than the means for the unistructed group. A statistically significant (p 0.05) difference between the two means was considered necessary to demonstrate that the difference in the means did not occur by chance. A T-test was used to determine if the differences between the means of the two groups were significant at the 0.50 level (Mason and Bramble, 1987).

Decision validity for the entire STCL and each section was determined by summing the percentage of uninstructed students who were classified as nonmasters of computer literacy and the percentage of instructed students who were classified as masters of computer literacy. Students who scored above the cut-off score were classified as masters of the content, and students who scored below the cut-off score were classified as nonmasters of the content. The number of instructed students classified as masters and the number of uninstructed students classified as nonmasters should be high to demonstrate that the decisions made based on the test scores are valid decisions. In other words, the higher the total percentage of students who performed on the test as they were expected to perform, the more decision validity the test contained (Hambleton, 1980).

Normative data for the two criterion groups, uninstructed and instructed college students, were collected for the entire STCL and each section of the test. The mean score, standard deviation, range, frequency distribution curves, and percentile scores were reported for the total STCL and each of its sections.

The final step in the development of the STCL was the preparation of a complete STCL package that was sponsored by the Iowa State University Research Foundation (ISURF) for publication. The components of the complete STCL package are the following: the Achievement Test containing 80 multiple choice test items divided into three sections, Computer Systems, Computer Applications, and Computer Programming; the Computer Anxiety Index containing 26 items; and the Test Administrator's Manual containing the definition of computer literacy, the competency list, the normative group tables, the administration instructions, and the Computer

Literacy Bibliography. The complete STCL package or any of its components may be purchased through the College of Education at Iowa State University. Scoring of the STCL may be accomplished at Iowa State University's Test and Evaluation Service. Individual and group scores, and item analyses are provided for the STCL and its subtests.

Results

The means, standard deviations, and ranges for the STCL and its sections for each criterion group are reported in Table 1. The mean scores for the instructed group were higher than the mean scores for the uninstructed group by one to two standard deviations for all sections of the test except the BACS (Ellsworth and Bowman, 1982). The mean scores for the BACS suggested that both instructed and uninstructed subjects had more positive attitudes about computers than negative attitudes since lower scores indicated positive attitudes toward computers. On a scale of 1-6, with 1 being the most positive, the mean scores coverted to average ratings were 2.27 for the instructed group and 2.50 for the uninstructed group.

The percentile scores and corresponding raw scores for the total STCL and its subtests for each criterion group are presented in Tables 2 and 3. These tables can be used to compare students' scores on subsequent testings of the STCL with similar or differing norm groups. The change in percentile scores for similar norm groups over many subsequent testings could be used to substantiate that students in a particular group, as a whole, are becoming more or less computer literate. The percentile scores of students could be used as guide for placing students in instructional treatments based on whether they score above or below a specified percentile.

The frequency distributions of raw scores for the total STCL and each subtest for both criterion groups are shown in Figures 1 through 5. The differences in the frequency distributions between the two criterion groups can be more easily seen and evaluated if the two distributions are shown on the same graph. The points of intersection of the two distribution curves for each section of the test were identified as the cut-off scores for classifying students as masters and nonmasters of the content measured by each section of the instrument. The resulting cut-off scores are reported in Table 4.

The steering committee evaluated the cut-off scores established with this method and concluded that the cut-off scores were not appropriate standards for classifying students as masters and nonmasters of computer literacy. The steering committee felt that computer literate individuals should be able to answer more of the items correctly than the cut-off scores suggested. The mean score for the instructed group in each section was considered a more appropriate cut-off score for each section of the test. The cut-off scores recommended by the steering committee are reported in Table 5.

Item statistics for each STCL test item were collected for both criterion groups and are reported in Table 6. The Difficulty Indices were determined by computing the percentage of students in each group who answered the item correctly. A range of 0 to 100 was possible, with 100 indicating the lowest level of difficulty. Two different Discrimination Indices were computed for each item.

The first Discrimination Index computed was the correlation between the item score and the total test score. A range of -1.00 to +1.00 was possible with +1.00 indicating the highest level of discrimination between the students within each group. The second Discrimination Index was the Uninstructed-Instructed Group Difference Discrimination Index (DIS_{uigd}) (Berk, 1980). It was computed by subtracting the Difficulty Index for the uninstructed group from the Difficulty Index for the instructed group, yielding an index of -100 to +100. The higher the index, the more the item discriminated between students in the instructed group and students in the uninstructed group.

Also included in Table 6 are the competencies measured by each item, the item-competency congruence rating from the judgmental analysis, and the number of subjects who omitted each item. An item-competency rating was not reported for items that were written following the judgmental analysis. However, they were written based on the suggestions of the computer specialists and were thus considered to be congruent with the competencies.

The STCL as a whole was shown to be very reliable, as reported in Table 7. The internal consistency reliability estimates were 0.86 for the instructed group and 0.91 for the uninstructed group. The internal consistency reliability estimates for the individual subtests were somewhat lower, but still indicated that the subtests were reliable for at least one of the criterion groups.

Content validity for the test items was established during the development of the instrument. The use of computer specialists to identify competencies that were representative of the domain of content, the writing of test items matched to the competencies, and the item and judgmental analyses all contributed positively to the content validity of the test.

Construct validity was demonstrated for the total STCL and its subtests by calculating the differences between the mean scores of the instructed and uninstructed groups and showing that the differences were statistically significant. The actual differences between the two criterion groups revealed that the mean of the instructed group was at least one standard deviation above the mean of the uninstructed group for every section except the BACS. T-tests were calculated to determine whether the differences were significant. The results of the T-tests, reported in Table 8, indicate that there were significant differences between the mean scores of the two criterion groups for the total STCL and each of its sections. This indicates that the differences did not occur by chance and helps to establish that the instrument is construct valid.

The STCL and each of its subtests were shown to have a high degree of decision validity because a high percentage of the students scored as their criterion group indicated they should. In other words, the higher the percentage of instructed students who scored above the established cut-off score and the higher the percentage of uninstructed students who scored below the cut-off score, the higher the decision validity of the instrument. The established cut-off scores and corresponding percentages are reported in Tables 4 and 5 for each of the methods used for establishing the cut-off scores. Both methods of establishing the cut-off scores yielded percentages of appropriately classified subjects that were high enough to indicate a high degree of decision validity.

Possible Uses of the STCL

There are several possible uses for the STCL. The primary goals for the STCL were to assess the computer literacy of students at various educational levels, and to guide the development of appropriate instruction so that all students could become computer literate. These primary goals could be accomplished by using the STCL in the following ways.

Cut-off scores could be established in order to identify various degrees of computer literacy. Student scores could be compared to these cut-off scores, and could then be used as one of the criteria for assigning students to courses appropriate to their degree of computer literacy. A cut-off score could be identified as one of the criteria necessary for students to test out of a particular course or segment of a course. For example, a student who scored above the cut-off scores on the Computer Systems and the Computer Applications sections of the STCL, but below the cut-off score on the Computer Programming section could be placed in a course dealing strictly with computer programming.

The STCL could be used to identify the specific computer literacy competencies possessed and not possessed by individuals in a particular course or group. The test items on the STCL are keyed to the competencies, so an examination of individual responses to each item could provide appropriate diagnostic information. Instruction could then be designed, or revised, to ensure that the students master the competencies that were lacking.

The STCL could be used to idenfify persons who are highly computer anxious. Anxiety towards computers may inhibit the subjects' interaction with computers and subsequently influence their level of computer literacy. Persons who are highly computer anxious may benefit from treatments designed to decrease their anxiety prior to receiving instruction about the cognitive aspects of computer literacy.

The STCL could be administered to a variety of norm groups for the collection of more comprehensive norm data. The normative information from a wide variety of groups could be used to identify groups in need of instruction. Subsequent administrations of the test to the same groups following instruction could provide valuable information about the quality of the instruction and could influence the revision of the instruction.

Summary of Results

1. The STCL was found to be a valid measure of computer literacy.
2. The STCL was found to be a reliable measure of computer literacy.
3. The STCL could be used as one of the criteria to classify students as computer literate or not computer literate.
4. The STCL could be used to facilitate decisions about the placement of students in computer literacy courses.
5. The STCL could be used to document the computer literacy competencies of students, and could be used in identifying instructional needs and goals.
6. The STCL could be used as a basis for the design and/or revision of appropriate computer literacy instructional programs.

Table 1. Means, standard deviations, and ranges of total STCL and subtests by criterion group

	Section II[a] Attitudes	Section III Systems	Section IV Applications	Section V Programming	Total[b] test
Mean score					
Instructed[c]	38.70	18.62	17.50	11.09	47.20
Uninstructed[d]	42.50	11.70	10.82	5.72	28.24
Standard deviation					
Instructed	9.49	3.83	4.31	3.79	10.18
Uninstructed	8.19	5.11	5.10	4.59	13.15
Actual range					
Instructed	25-64	8-27	0-26	0-20	13-69
Uninstructed	23-62	0-25	0-23	0-19	2-63
Possible range	17-102	0-29	0-28	0-23	0-80

[a] Part One, the Beliefs About Computers Scale (Ellsworth and Bowman, 1982): the lower the score, the more positive the attitude toward computers.

[b] Total score for Sections III, IV, and V combined.

[c] N=152.

[d] N=110.

Table [illegible]. Percentile scores and corresponding raw scores for [illegible] and subtests for instructed criterion group

%tile	Raw Scores by Section					
	II[a]		III[b]	IV[c]	V[d]	Total[e] test
	Part 1	Part 2				
100	64	-	27	26	20	69
99	63	5.0	26	25	19	68
98	59	-	-	-	18	-
97	56	4.6	25	-	-	64
95	53	-	24	24	-	62
94	-	4.0	-	-	17	-
93	-	-	-	23	-	61
92	-	3.8	-	-	-	-
91	49	3.6	23	-	16	-
90	-	-	-	-	-	60
89	-	-	-	22	-	-
88	48	-	-	-	-	-
87	-	-	-	-	-	59
86	-	3.4	-	-	15	-
85	-	-	-	-	-	58
84	47	-	22	21	-	-
82	-	-	-	-	-	57
81	46	-	-	-	14	56
78	45	3.2	-	-	-	55
77	-	-	-	20	-	-
76	-	-	-	-	-	54
75	44	-	21	-	-	-
72	43	-	-	-	13	53
70	42	-	-	-	-	-
69	-	3.0	-	-	-	-
68	41	-	-	-	-	-
66	-	-	-	-	-	52
64	-	-	-	19	-	-
63	-	-	20	-	12	51
61	40	-	-	-	-	-
59	-	2.8	-	-	-	50
58	-	-	19	-	-	-
57	-	-	-	-	11	-
56	39	-	-	-	-	49
55	-	-	-	18	-	-
53	-	-	-	-	-	48
50	-	-	-	-	-	47
49	38	-	18	17	-	-
47	-	2.6	-	-	-	-
46	-	-	-	-	10	46
43	-	-	-	-	-	45
41	37	-	-	-	-	-
40	-	-	17	16	-	-
38	36	-	-	-	-	44
35	-	2.4	-	-	-	43
34	35	-	-	-	9	-
31	-	-	-	-	-	42
30	34	-	-	-	-	-
28	-	-	16	15	8	41
24	33	2.2	-	-	-	40
22	-	-	15	-	-	38
14	31	2.0	14	13	-	-
12	30	-	-	12	-	34
9	29	-	-	-	-	33
8	-	1.8	-	-	-	
4	26	1.6	-	-	-	29
3	25	-	11	9	-	27
2	5	-	10	-	4	-
1	2	1.4	9	7	3	26

---

[a] Computer Attitudes. Part 1 is the Beliefs About Computers Scale (Ellsworth and Bowman, 1982) with a possible range of 17-102, 17=most positive computer attitude. Part 2 is the Computer Anxiety Index (Maurer, 1983) with a possible range of 1-6, 6=highest level of computer anxiety.

[b] Computer Systems (maximum possible score=29).

[c] Computer Applications (maximum possible score=28).

[d] Computer Programming (maximum possible score=23).

[e] Sections III, IV, V combined (maximum possible score=80).

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Table 3. Percentile scores and corresponding raw scores for STCL and subtests for uninstructed criterion group

%tile	II[a] Part 1	II[a] Part 2	III[b]	IV[c]	V[d]	Total[e] test
100	62	-	25	23	19	63
99	61	5.0	24	-	18	-
98	-	-	-	-	17	62
97	58	4.6	23	22	-	58
96	57	-	21	-	16	57
95	56	-	20	21	15	55
94	-	4.0	-	-	13	-
93	-	-	19	19	-	52
92	54	3.8	-	18	12	-
91	53	3.6	-	-	-	48
90	52	-	-	-	-	45
89	-	-	18	17	-	-
88	-	-	17	-	-	44
86	-	3.4	-	-	11	43
85	-	-	-	16	10	42
83	50	-	-	-	-	39
81	-	-	-	-	9	38
80	49	-	16	-	-	37
79	-	-	-	14	-	36
78	48	3.2	-	-	-	-
77	-	-	15	-	-	35
75	-	-	-	13	8	-
74	-	-	-	-	-	34
69	-	3.0	-	-	7	-
68	46	-	13	-	-	33
63	-	-	-	-	-	31
60	-	-	-	-	-	30
59	44	2.8	-	11	-	29
56	-	-	-	-	5	-
51	43	-	-	-	-	27
50	-	-	-	10	-	-
47	-	2.6	11	-	-	-
46	42	-	-	-	-	-
45	-	-	-	9	4	25
43	-	-	10	-	-	-
42	41	-	-	-	-	24
39	40	-	-	-	-	23
36	-	-	-	-	3	-
35	39	2.4	9	8	-	-
31	38	-	-	-	-	-
28	-	-	-	-	2	20
26	36	-	8	-	-	-
25	-	-	-	7	-	19
24	-	2.2	-	-	-	-
23	-	-	-	-	1	-
20	-	-	7	-	-	18
15	-	-	6	6	-	17
14	33	2.0	-	-	-	-
13	-	-	-	5	0	14
10	31	-	5	-	-	12
8	-	1.8	-	4	-	10
7	-	-	4	-	-	9
5	28	-	3	2	-	8
4	-	1.6	2	-	-	5
3	27	-	-	1	-	3
2	25	-	1	0	-	2
1	23	1.4	0	-	-	-

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[a] Computer Attitudes. Part 1 is the Beliefs About Computers Scale (Ellsworth and Bowman, 1982) with a possible range of 17-102, 17=most positive computer attitude. Part 2 is the Computer Anxiety Index (Maurer, 1983) with a possible range of 1-6, 6=highest level of computer anxiety.

[b] Computer Systems (maximum possible score=29).

[c] Computer Applications (maximum possible score=28).

[d] Computer Programming (maximum possible score=23).

[e] Sections III, IV, and V combined (maximum possible score=80).

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Table 4. Cut-off scores (Berk, 1976) for total MTCL and subtests and percentages of criterion groups classified as masters and nonmasters of the content

Section of test	Cut-off[a] score	Percentage of criterion groups appropriately classified as masters and nonmasters of the content		
		Uninstructed[b] (N=110)	Instructed[c] (N=152)	Both groups[d] (N=262)
III. Systems	14	68	89	81
IV. Applications	13	70	88	81
V. Programming	6	56	95	79
Total test	37	78	84	81

[a] Cut-off was determined by the point of intersection between the frequency distribution curves for the uninstructed and instructed criterion groups (Berk, 1976).

[b] Percentage of uninstructed group who scored below the cut-off score.

[c] Percentage of instructed group who scored above the cut-off score.

[d] Percentage of both groups who scored above or below the cut-off score as their criterion group indicated they should.

Table 5. Cut-off scores set by steering committee for total MTCL and subtests and percentages of criterion groups classified as masters and nonmasters of the content

Section of test	Cut-off[a] score	Percentage of criterion group appropriately classified as masters and nonmasters of the content		
		Uninstructed[b] (N=110)	Instructed[c] (N=152)	Both groups[d] (N=262)
III. Systems	19	90	51	67
IV. Applications	18	90	51	67
V. Programming	11	85	54	67
Total test	47	92	54	70

[a] Cut-off was determined by the judgments of the steering committee to be the mean score for the instructed group.

[b] Percentage of uninstructed group who scored below the cut-off score.

[c] Percentage of instructed group who scored above the cut-off score.

[d] Percentage of both groups who scored above or below the cut-off score as their criterion group indicated they should.

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Table 6. [illegible] test-item analysis data from instructed and uninstructed criterion groups

Item	Comp[a]	I-C[b]	Uninstructed Omits[c]	Uninstructed Diff[d]	Uninstructed Disc[e]	Instructed Omits	Instructed Diff	Instructed Disc	DIS$^{f}_{uigd}$
1	S1	4.6	19	53	.41	2	69	.32	16
2	S2	4.2	6	80	.21	2	91	.21	11
3	S3	4.0	7	74	.49	0	87	.33	13
4	S4	4.2	5	55	.36	0	70	.02	15
5	S4	4.6	6	64	.46	0	78	.22	14
6	S5	4.2	34	25	.27	2	41	.26	16
7	S6	4.6	22	36	.53	0	36	.33	0
8	S7	4.4	13	55	.62	0	82	.34	27
9	S8	–	8	63	.37	0	78	.15	15
10	S9	3.8	20	62	.60	0	[illegible]	.10	27
11	S9	4.2	15	53	.48	1	[illegible]	.32	22
12	S10	3.7	12	64	.37	0	[illegible]	.28	–8
13	S11	4.7	27	20	.20	1	20	.09	0
14	S12	4.6	24	42	.12	0	50	.16	8
15	S13	–	11	39	.23	0	62	.27	23
16	S14	–	11	30	.48	0	39	.18	9
17	S15	4.2	15	61	.63	1	77	.26	16
18	S16	4.4	4	55	.38	0	70	.42	15
19	S16	4.6	11	46	.39	2	77	.18	31
20	S17	4.4	38	24	.49	1	55	.25	31
21	S17	4.0	34	37	.54	0	61	.29	24
22	S18	3.0	17	55	.34	1	51	.09	4
23	S19	4.5	12	37	.58	0	43	.25	6
24	S20 S21	– –	31	16	.09	1	55	.51	39
25	S20 S21	– –	21	47	.49	1	72	.42	25
26	S22	4.8	15	46	.38	0	93	.31	47
27	S23	3.4	20	39	.47	0	63	.30	24
28	S24	–	9	19	.25	0	37	.17	18
29	S25	4.0	7	48	.30	0	92	.19	44
30	A1	3.0	11	47	.04	3	51	.20	3
31	A2	–	11	60	.48	2	55	.44	–5
32	A3	–	9	41	.29	1	64	.30	23
33	A4	4.0	4	87	.47	1	98	.28	11
34	A5 A6	3.0 4.5	5	50	.40	3	76	.44	26
35	A7	4.3	5	62	.57	1	87	.38	25
36	A7	4.0	5	21	23	1	32	.23	11
37	A8	3.8	5	59	.41	1	75	.46	16
38	A9	4.8	9	71	.58	2	93	.25	22
39	A10 A11	4.2 –	22	52	.60	2	81	.42	29

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[a] Competency that item measures. Code refers to the section of the test (System-S, Applications-A, Programming-P) and the number of the competency from the list of competencies in Appendix E.

[b] Item-competency congruence (mean rating of judges on a scale of 1-5, 5=high congruence).

[c] Number of students who omitted the item.

[d] Difficulty Index (percent of students who answered item correctly, 0-100).

[e] Discrimination Index (item-score correlation, -1.00-1.00).

[f] Uninstructed-Instructed Group Difference Discrimination Index ($Diff_I$ - $Diff_U$, -100 - +100).

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Table 3. (continued)

			Uninstructed			Instructed			
Item	Comp[a]	I-C[b]	Omits[c]	Diff[d]	Disc[e]	Omits	Diff	Disc	SIS^f_{sigd}
40	A10	4.6	28	52	.77	2	81	.48	29
41	A11 A12	4.2 4.2	21	12	.32	1	82	.21	70
42	A13 A12	- 4.0	34	36	.36	2	89	.30	53
43	A13 A14	- -	13	34	.39	1	30	.43	-4
44	A15 A14	- -	12	54	.40	1	33	.30	-21
45	A16	4.3	12	38	.41	1	40	.36	2
46	A18 A16	- -	15	75	.62	1	92	.36	17
47	A17 A19 A18	3.6 4.4 5.0	11	60	.43	1	62	.42	2
48	A20	4.0	15	17	.09	1	68	.37	49
49	A21	3.6	20	30	.56	1	58	.22	28
50	A22	-	20	59	.66	1	34	.37	25
51	A23	-	13	46	.28	1	48	.27	2
52	A22	-	18	27	.07	2	29	.11	12
53	A23 A25 A24	- - 5.0	12	41	.36	1	66	.23	25
54	A25 A24	3.0 4.6	16	47	.40	1	70	.42	23
55	A25 A24	4.0 -	21	31	.39	2	47	.40	16
56	A25 A24	- -	14	13	.27	1	23	.15	10
57	A25 A25	- -	24	22	.62	1	48	.40	26
58	P1	3.4	17	41	.37	1	44	.34	3
59	P2 P3	3.4 4.7	26	45	.75	2	67	.51	22
60	P3	4.6	30	25	.51	2	45	.26	20
61	P4	5.0	25	61	.48	3	64	.21	3
62	P5	5.0	25	71	.58	1	82	.37	11
63	P5	5.0	26	61	.73	1	73	.36	12
64	P6	4.6	34	36	.73	1	58	.50	14
65	P4	4.4	39	46	.66	7	62	.25	-4
66	P7 P8	- 3.5	37	15	.46	1	48	.32	33
67	P8	3.5	37	45	.63	1	63	.21	18
68	P9	5.0	39	27	.39	1	45	.22	18
69	P9	5.0	32	49	.67	1	56	.35	7
70	P10	3.8	28	16	.36	1	77	.52	61
71	P11	3.0	34	20	.41	1	25	.24	5
72	P2	4.4	39	21	.56	2	26	.20	5
73	P7 P12 P14 P15	- - - 4.6	41	38	.77	2	65	.25	27
74	P15	4.8	41	61	.09	2	80	.33	19
75	P16 P15	4.8 4.8	44	30	.58	2	30	.40	0
76	P15	4.0	42	41	72	2	32	.39	-0
77	P13 P17	3.8 4.8	42	34	.46	2	31	.15	-3
78	P18	-	72	21	-.07	14	24	.04	3
79	P19	-	72	29	.68	15	37	.33	8
80	P20	-	74	22	.14	21	24	.19	4

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Table 7. Reliability estimates for total STCL and subtests by criterion group

Criterion group	Section II[a] Attitudes	Section III Systems	Section IV Applications	Section V Programming	Total[b] test
Instructed	0.81[c]	0.64[d]	0.75	0.69	0.86
Uninstructed	0.73	0.78	0.80	0.81	0.91

[a] Part One, the Beliefs About Computers Scale (Ellsworth and Bowman, 1982).

[b] Sections III, IV, and V combined.

[c] Coefficient alpha.

[d] Kuder-Richardson 20 reliability coefficient (Sections III, IV, V, and total).

Table 8. Comparison of STCL test scores of instructed versus uninstructed criterion groups

	Number	Mean	S.D.	T-Value	2-Tailed Probability ($p < .001$)
Section II					
Instructed	152	38.7	9.5	3.38	0.001**
Uninstructed	110	42.5	8.2		
Section III					
Instructed	152	18.6	3.8	-11.92	0.001**
Uninstructed	110	11.7	5.1		
Section IV					
Instructed	152	17.4	4.4	-11.23	0.001**
Uninstructed	110	10.8	5.1		
Section V					
Instructed	152	11.2	3.8	-10.16	0.001**
Uninstructed	110	5.7	4.6		
Total test					
Instructed	152	47.2	10.2	-12.58	0.001**
Uninstructed	110	28.2	13.2		

** $p < .01$.

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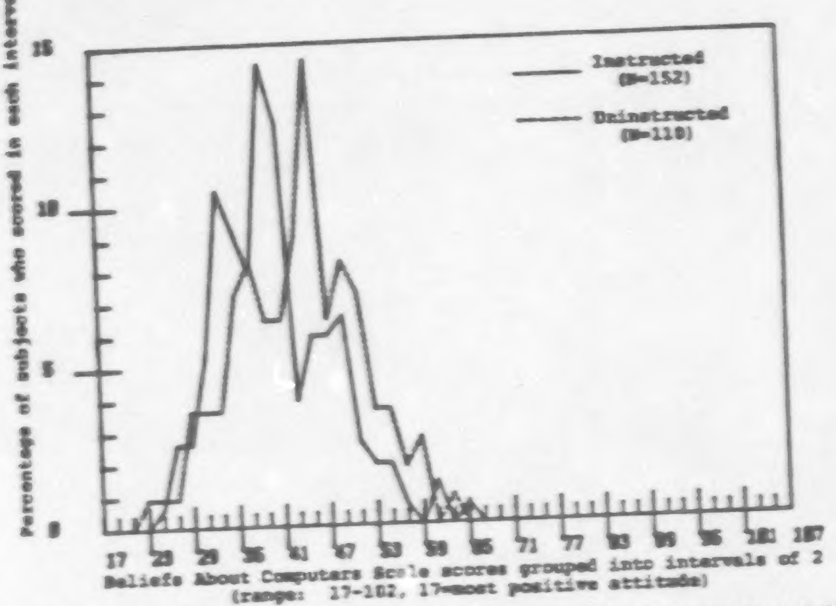

Figure 1. Frequency distributions of scores for MECL Section II, Part One (Beliefs About Computers Scale) by criterion group

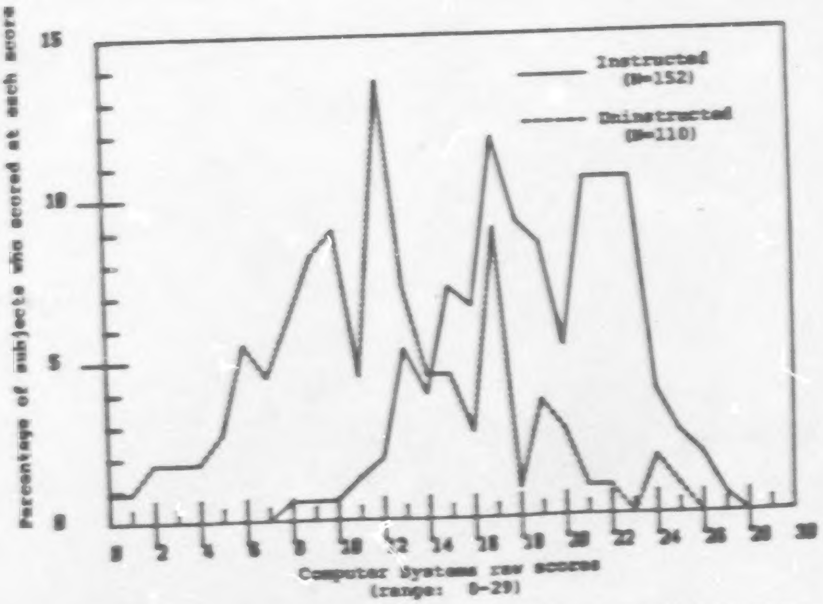

Figure 2. Frequency distributions of scores for MECL Section III (Computer Systems) by criterion group

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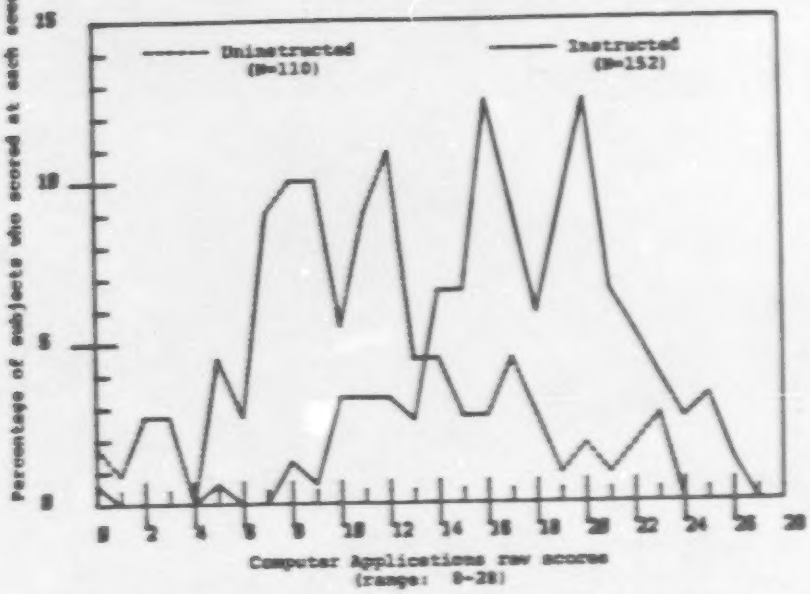

Figure 3. Frequency distributions of scores for [illegible] Section IV (Computer Applications) by criterion group

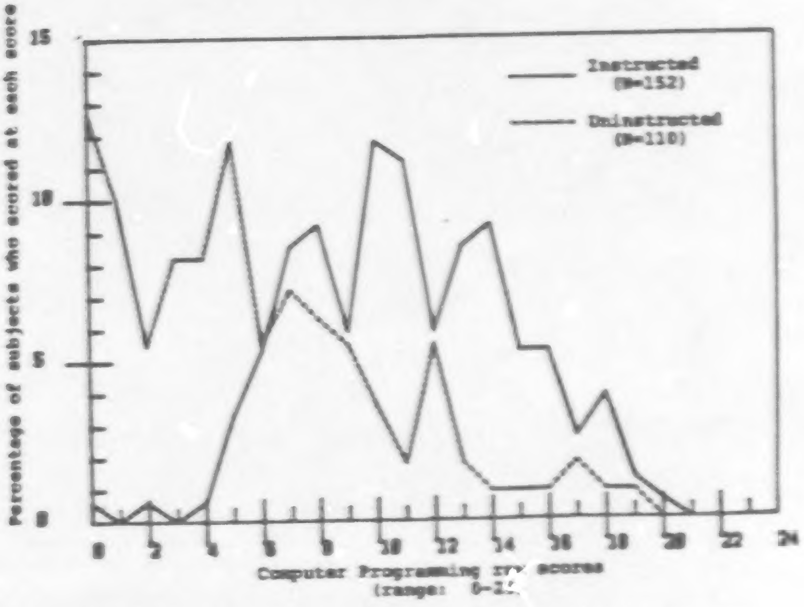

Figure 4. Frequency distributions of scores for [illegible] Section V (Computer Programming) by criterion group

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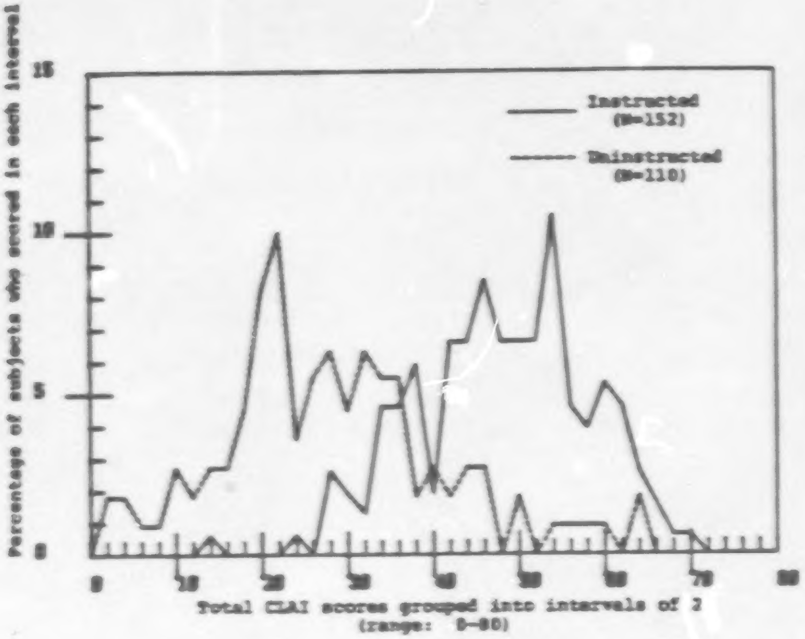

Figure 5. Frequency distributions of scores for total [illegible] by criterion group

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EFFECT OF INTEGRATED CBI PRACTICE ON TASK PERFORMANCE AND ATTITUDE

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ABSTRACT

This study investigated the effects of integrated CBI practice on criterion task performance and attidudes of learners. Twenty two subjects participated in the study, 11 in a treatment group and 11 in a control group. All subjects took a CBI lesson that taught them to use a communications software package to transfer files between a personal computer and a VAX. The lesson taken by subjects in the treatment group included an additional section that allowed them to practice the task without initial instructional prompts. Then each subject used the software package to do the file transfer task. Subjects who took an additional practice section completed the file transfer in, on average, half as long as the subjects who did not have the practice section ($p < .001$). They also made fewer errors ($p < .01$). There was only a slight difference between control and treatment groups on total attitude score. However subjects in the control group were much more likely to indicate a desire for additional review than subjects from the treatment group.

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PURPOSE OF THE STUDY

Computer-based instruction (CBI) courses are often designed to teach the computer user how to perform a series of steps that result in the performance of a target task, such as transfering of a file between two computers, or creating and editing a letter. Common sense, informed by precepts of instructional design (Briggs, 1977; Dick and Carey, 1974; Gagne and Briggs, 1979), and instructional effectiveness research findings (Hull, 1952; Bugeshi, 1964; Mowrer, 1960), would dictate that a course which allows the user to practice the entire sequence of steps that comprise a task, chained together, would be more effective in teaching the target task than a course which merely allows users to practice each step in isolation. Research findings (Tobias, 1973; Bloom, 1974; Berliner, 1979; Rosenshine, 1979) further suggest that, generally, any instructional method or procedure which results in students spending more time actively engaged in the learning of a task results in higher achievement.

However, many courses simply present concepts and tell the learner about the steps they will perform to accomplish a specific task or tasks. At best, the course may allow the learner to practice each step in isolation. This type of course design probably has not evolved from any firmly held convictions about its instructional effectiveness. Rather, it is more likely the result of real cost and time constraints that inevitably impact CBI course design. At some point decisions are made, perhaps by default, that the additional time required to include practice exercises that more closely approximate the tasks learners must ultimately perform outweigh the possible benefits that might accrue from such practice.

Costs associated with the development of a CBI lessons with integrated practice include the time necessary to plan and implement the practice exercise. Balanced against these costs are the possible benefits which might result from users performing the target tasks more quickly and with fewer errors as a result of the additional practice. If users do, in fact, use the target software with more ease and precision they may feel more less frustrated and more confident about their newly acquired skills.

It was the purpose of this study to assess the benefits associated with CBI course designs that include practice sessions that realistically simulate the task to be learned as well as the presentation of concepts and practice of individual steps. It is not possible, within the confines of this study, to determine whether the costs outweight the benefits, or vice versa. It was merely our purpose to conduct a comparative study of CBI instruction that did and did not include integrated practice and to present our findings. These findings represent one source of data that instructional designers may consult to inform their decisions about course content and structure.

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DESIGN OF THE STUDY

Subjects

In this study, 22 subjects were randomly assigned to either a treatment or a control group. Subject included 16 Boston College undergraduate and graduate students, all of whom had taken at least one computer course, and 6 professional instructional designers of computer-based instruction.

Procedure

A research assistant explained to each subject that the purpose of the study was to help assess the effectiveness of different types of course design. Then the assistant briefly explained the personal computer and the communications software package that was the subject of the CBI course used as a treatment in the study.

Each subject took two CBI lessons that were taken from a larger course. The first lesson was an introductory lesson designed to teach computer communications concepts. This first lesson did not vary for treatment and control groups. The second lesson taught how to transfer a file using the communications software. The format and content of this second lesson was varied to reflect the major question addressed by this study.

For the control group, this lesson included an introduction to file transfer, an explanation of each step of the file transfer process accompanied by the opportunity for the learner to practice each step, and a summary. The lesson taken by the treatment group included an additional section that was inserted before the summary. This section was designed to enable learners to practice doing all of the steps being taught in the task sequence without interruption and without prompting. This section of the lesson was designed to reflect what a user would do when working with the communications software, i.e. enter a series of commands to perform a given task with no explicit prompting from the system. Subject in the treatment group were given prompts only when they answered incorrectly after two tries. After an incorrect first entry, subjects were asked to try again. After the second try, they were given an informational hint. Finally, after the third incorrect response, they were given the correct response.

Because of the additional instruction taken by subjects in the treatment group, it took them longer, on the average, to complete the CBI instruction. The average time required for control group subjects to complete the two CBI lessons was 17 minutes while the average time for subjects in the treatment group was 21 minutes.

Subjects in both groups were permitted to take notes, if they wished, and were told in advance that after the lessons they would use

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the sofware about which they were learning. Both groups were also told that they could repeat any part of the lesson they wished.

When each subject had finished taking the CBI, s/he was assisted by a second research assistant who did not know whether the subject had been assigned to the treatment or control group. The research assistant, reading from a prepared text, explained the task that the subject was to perform. The task involved actually performing a file transfer using a personal computer connected by a modem to a VAX computer.

Subjects were observed while performing the task by the second research assistant. Subjects' comments and actions, as well as correct and incorrect responses were recorded on an observation protocol. A task performance score was computed for each subject based on responses. The total number of minutes required to perform the task, rounded to the nearest minute, was also recorded. After the task was completed, an attitude questionnaire was administered to each subject. The questionnaire was designed to assess each subject's opinion of how adequately they felt the instruction had prepared them to do the file transfer task. Students rated themselves on a scale from strongly agree (6) to strongly disagree (1) on each item.

RESULTS

Task Performance

Subjects in the treatment group, on average, performed better on the criterion task than did subjects in the control group (see Table 1). Out of a total possible of 27 points that could be derived from the task performance scoring procedure, the average score for the treatment (practice) group was 24.91 with a standard deviation of 2.21. High and low scores were 27 and 21, respectively. The average score for the control group was 20.36 with a standard deviation of 4.23. The highest score for the control group was 25 and the lowest was 13. As these data indicate, there was much less variability among the scores of subjects in the treatment group as compared to the scores of subjects in the control group. The results of statistical analysis using a one-tailed t-test to assess the significance of the difference between mean scores of the two groups yielded a probability level of .01

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Table 1
Mean Task Performance Scores

TREATMENT N = 11	CONTROL N = 11	t-test
24.91	20.36	p < .01
sd = 2.21	sd = 4.23	

The most impressive difference between treatment and control groups was observed when average times to complete the criterion task were compared. It took subjects in the control group nearly twice as long, on average, to complete the target task as it took subjects in the treatment group. As can be seen in Table 2, the mean for the treatment (practice) group was 4.81 minutes while the mean for the control group was 8.90 minutes. A one-tailed t-test indicated a significance level of .001. As can be discerned from the standard deviations reported in Table 2, there was again more variability among subjects in the control group than among subjects in the treatment group. The fastest subject in the control group completed the task in 3 minutes and the slowest subject in that group took 8 minutes. In contrast, the fastest person in the control group completed the task in 5 minutes, while the slowest required 14 minutes.

Table 2
Mean Time to Complete Task

TREATMENT N = 11	CONTROL N = 11	t-test
4.82 min.	8.91 min.	p < .001
sd = 1.66	sd = 2.66	

Attitude of Subjects

Responses to the attitude measure were analyzed for each item for the control group and treatment group. Items were categorized as High Agreement if the majority of students rated themselves as 3 (agree) or 4 (strongly agree), or Low Agreement if most students rated themselves as 2 (disagree) or 1 (strongly disagree) on that item.

The results are presented in Table 3. The ratings for the groups differ only for item 3. The majority of control group subjects agreed

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whereas a majority of the treatment group subjects disagreed with the statement that they wished they could have reviewed the lesson again. Only a slight difference was observed between the control and treatment groups overall on the attitude measure.

Table 3
Summary of Results of Attitude Self Ratings

ITEM	AGREEMENT TREATMENT	 CONTROL
1. I felt I had the information I needed to be able to use the software to transfer a file.	HI	HI
2. I felt very frustrated.	LOW	LOW
3. I wish I had had a chance to review the lesson again.	LOW	HI
4. I felt I understood how to use the software to transfer a file.	HI	HI
5. I just didn't know what to do.	LOW	LOW

DISCUSSION

The results of this study support the premise that learners are more likely to successfully accomplish a target task that is comprised of many individual steps when they have had a chance to practice the steps in sequence. This outcome, while not surprising, has interesting implications for the design of computer-based instruction.

Social psycholgists have long argued that people strive for competence, that sense of efficacy that comes with the perception that's one's environment is understandable and manageable. (Smith, 1968). More simply put, people like to succeed. When success means entering a series of commands that may have no contextual meaning to a novice computer user, as one instructional designer put it, "people need all the help they can get."

The subjects in the treatment group had the opportunity to practice what they had just been taught in the CBI lesson before demonstrating their mastery of the lesson by performing a file transfer task. The additional help provided by the practice exercise

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in the experimental treatment was well received by subjects.

They indicated that the practice "made them feel more comfortable" with the software. One subject noted that while she enjoyed taking the CBI, it wasn't until the practice session that she felt very confident to perform the task. Said another Boston College subject "It's just like teaching ... it helps if you review and (practice) the lesson."

It is this self-directed practice that is often missing from computer-based instruction. It is interesting that while subjects in the treatments were told they could review the CBI and the practice session as many times as they wished, no one reviewed the CBI lessons. Four of the eight Boston College students who took the practice session reviewed the session before beginning the target task. It is not surprising that all four of these students attained a perfect task performance score of 27. Their average task completion time was 3.6 minutes. When given the opportunity to practice until they achieved mastery, these subjects did so.

Some users of computer-based instruction have indicated that it is a big shock to go from the supportive environment of a CBI course to the actual software the course teaches about. The applications software may provide understandable error messages when the user makes a syntax error. However if the user simply forgets the correct sequence of commands and enters an inappropriate command, such help is not available.

It is possible that a practice session like the one included in this study could help bridge the gap between supportive instructional courseware and the hard realities of the applications software. The practice session included no direct instruction and only offered hints after two unsuccessful tries. Thus the users had a chance to try to do the task on their own, but they were not permitted to fail. Practice is, after all, what most of us do after we have been taught something that involves the memorization of a sequential task. We practice until we get it right. It is probably much more satisfying for the learner to practice in an instructional setting than in the work environment where lack of success may have more serious consequences.

SUMMARY

The purpose of this study was to assess the extent to which a CBI lesson that includes a practice session is more effective than a CBI lesson that does not include such a practice sessin. Subjects in a control group took a CBI lesson designed to teach the user to transfer a file between a personal computer and a VAX computer using a communications software package. The control group lesson included a section explaining the file transfer and a simulation of the file

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transfer process during which the user practiced each step of the process as it was presented. The subjects in the treatment group took the same lesson, with an added practice section which allowed them to practice the file transfer proces with no instruction or prompts. If the subject made an error, feedback was provided.

At the end of the treatment, each subject performed a file transfer using the communications software package. Subjects were observed and each correct and incorrect response was recorded. A task performance score was computed, and the time required to do the task was measured for each subject. An attitude survey was administered to each subject to assess how the subject felt about the instruction and their ability to perform the file transfer process.

There were statisticallty significant differences between control and treatment groups both on task performance and task time. The treatment group made fewer mistakes performing the file transfer task than the control group, and were able to accomplish file transfer in, on average, half the time that the control group required. Despite these differenes, there was only a slight difference between the attitude survey averages of the control and treatment groups.

Although the findings of this study are based on a small sample (22) subjects, the finding that the treatment group performed the file transfer in about half the time that the control group required is notable. This study suggests that the inclusion of well designed practice sessions results in substantial gains in user performance of the objectives the course is designed to teach.

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Tying it all Together:
Synthesizing Strategies for Computer-based Instruction

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Running head: Synthesizing strategies

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Abstract

Computer-based instruction (CBI) is composed of individual frames viewed one at a time. Compared to a typical textbook, CBI restricts the adult learner's capacity to (1) access information from different parts of the lesson and (2) view complex presentations. Designers of CBI must compensate for these limitations by making a concerted effort to synthesize or tie together content parts, resulting in a coherent, stable cognitive structure in the learner's mind. Six synthesizing strategies are discussed and illustrated. Greater attention to content synthesis will result in more meaningful CBI materials. Research on CBI strategies is related to a framework for a science of instruction; potential research questions are discussed.

Tying it all Together:

Synthesizing Strategies for Computer-based Instruction

The purpose of this paper is to propose some instructional strategies that can help synthesize content presented in a computer-based instructional (CBI) lesson. To explain why content synthesis is needed, and provide a background to the paper, we will first review some basic differences between CBI and hard-copy media and define "content structure." Following a description of content synthesis strategies, we relate CBI research to a broader science of instruction.

Constraints of the Medium

Amid the recent excitement generated by computers in education among educators, some concerns remain regarding the quality of CBI learning outcomes. Most CBI systems exhibit two main constraints:

1. Limited information display. Most CBI programs use a 40 or 80 column by 24 row display. In practice, a CBI frame is not much larger than the teaching machine frames used in programed instruction twenty years ago (Skinner, 1968; Markle, 1969). Human factors research has shown that reading from a CRT display is more difficult and causes more eyestrain than reading from hard-copy materials (Campbell, et al., 1981). CBI as an instructional medium is not suited to dense information display.

2. Limited frame access. Access to individual frames may be accomplished by special commands (control characters, special functions, etc.) or by a menu selection. In either case, because of the complexity of the logic and the cost of development, direct access to individual frames is extremely rare in CBI. CBI becomes less valuable as a reference source

and, to the degree that frame access is an important learner strategy, less valuable as a learning device.

Two main problems result from the constraints described above. The first problem is related to the lack of learner control over information presented (M. D. Merrill, 1973). Materials that do not allow adult learners some control over instructional events must carefully monitor and assess student learning throughout the program; in short, they must be adaptive systems (Atkinson, 1976). Otherwise, learning is likely to suffer in efficiency and, to some degree, effectiveness. Although considerable resources have been devoted to intelligent computer-aided instruction or ICAI (Walker & Hess, 1984), the development costs of sophisticated adaptive systems presently inhibit their widespread use.

The second problem has more to do with the limited display capacity of CBI systems. An essential step in CBI design is careful analysis of the content, breaking tasks down into small chunks that can be taught and tested using a frame-based system. Unfortunately, large doses of small chunks can lead to shallow, superficial comprehension of the overall subject. There can be a lack of content synthesis (Reigeluth & Stein, 1983). Concepts are often not adequately integrated together; learners lack an understanding of how things fit together. This notion of how content fits together is referred to as content structure (Merrill, Kowallis, & Wilson, 1981; Wilson, 1985). Failure to grasp the content structure, according to schema theorists (Rumelhart & Ortony, 1977; M. D. Merrill, Wilson, & Kelety, 1981), leads to rapid forgetting of the material. Conversely, as content structure is better learned, learning becomes more meaningful and stable (Reigeluth, 1983; Ausubel, 1968).

Synthesizing Strategies

What can be done to enhance meaningful learning in a CBI environment? There is, of course, no simple formula to be followed. In this paper we discuss six specific instructional strategies that can help synthesize different parts of a subject into a stable cognitive structure within the learner's mind.

1. Use hard-copy adjunct aids such as diagrams, figures, and content outlines. Figure 1 portrays a tree diagram intended for adjunct use with a CBI program. The tree diagram summarizes the essential concepts taught in the CBI lesson.

Insert Figure 1 about here

Hard-copy support materials seem to be neglected in many CBI systems. Hard-copy materials can be valuable for a number of reasons:

* Display of information frequently accessed in the lesson
* Display of figures too complex for effective CRT display
* Reinforcement of CBI content using another media
* Take-home materials to serve as reference and reminder of lesson content

Even the most sophisticated CBI environment would do well to make use of hard-copy reference materials; students often appreciate the "Look what I learned!" quality of a handout or booklet.

The paucity of hard-copy support materials in CBI packages may be a blessing in disguise for many teachers. Integrating CBI into an existing curriculum is a critical task for teachers (Salisbury, 1984). The preparation of simple support materials is an important way teachers can adapt CBI products for use in a preexisting curriculum plan. This, of course, requires some effort, but the value of adjunct materials helps make it worthwhile (Wilson, 1984).

2. Implement learner control features such as menus and HELP options. Learner control strategies include any design features that require input from the user regarding instructional decisions. Examples include options to skip a problem, receive help on a problem, backtrack to the previous frame, or move to a different lesson. Tennyson & Buttrey (1980) have shown that students can make intelligent decisions about instruction, particularly when relevant information is available to them.

Learner control features can aid content synthesis. Structurally central content can be made available on HELP selections. Allowing "scanning" by skipping practice problems can help a learner develop a preliminary schema to subsume the topic.

Allowing a variety of sequences through the lesson can make it more likely that the learner's existing cognitive structure indeed matches the assumed prerequisites of the presentation.

Allowing for learner control is the designer's way of admitting the program is not a foolproof, deterministic solution to every user's needs. Rather than expecting the program to provide all the answers, a program allowing learner control places greater responsibility in the hands of the learner to control the learning pace, sequence, and direction. Although research has clearly shown that learner control is not the cure-all for CBI design (Steinberg, 1977), prudent use can contribute to content synthesis.

3. Use graphic synthesizers such as lesson maps, diagrams, and other figures to periodically orient the learner toward the content structure. The same figure used as an adjunct aid in Figure 1 was also included in the CBI program itself. Note the relative simplicity of the diagram; more complex figures and diagram, while possibly providing more information, become unsuitable or display on a CRT screen.

Other kinds of diagrams can be very useful. Simple flowcharts can portray direction and sequence. TICCIT (Merrill, Schneider, & Fletcher, 1980) used course maps as a means of orienting learners toward the structure of the lessons.

The value of figures and pictures in hard-copy instruction has been demonstrated in research and practice (Levie & Lentz, 1982; Alesandrini, 1984). The use of a tree diagram representing the content structure can help learners acquire a hierarchy of concepts as well as improve their attitude toward the lesson (Wilson & Merrill, 1980; Wilcox, Merrill, & Black, 1981). Several researchers have offered design guidelines to maximize the effectiveness of graphic displays (Brody, 1984; MacDonald-Ross, 1978; P.F. Merrill & Bunderson, 1981). While increasing attention has been given to electonic display design (P.F. Merrill, 1982; Alesandrini, 1984), the unique problems of electronic figures and diagrams are still not well understood. The information-display constraints of electronic media require simple, direct figures that can be easily conveyed on the screen. This may account for the seeming absence of content-relevant graphics in most CBI products available today.

4. Use animation, graphics, sound, and timing to highlight structurally central content parts. Any instructional message contains more information than the learner can be expected to encode and have available for recall. Is the exact wording of a paragraph important? The specifics of an example used? The question for designers is, what parts of the presentation do we expect the learner to remember and use, and how do we communidate that intent to the learner, thus sharing the responsiility for the outcomes of instruction? One way we can "tip off" the learner to

these intentions is by presenting stated objectives: "At the conclusion of this lesson, you will be able to..." Another important way learners catch on to instructional intentions is by observing cues such as highlighting, headings, and paragraph structure. (Anderson & Faust, 1974; Duchastel, 1982). These cues should support and not detract from a clear exposition of the content structure.

The cues available to CBI designers are numerous:

a. Graphics and animation. Graphics are often used as "frills"--entertaining spots unrelated to the content of the lesson. This is a great waste of potential. Visual displays can communicate content structure. Animation, usually used for cartoon amusement, can be intrinsic to the subject matter and convey critical information (Malone, 1981).

b. Use of space. The screen layout and balance should focus on structurally important parts of the message. This can be done by careful use of white space.

c. Sound. Sound is another form of information, often used successfully as a means of performance feedback.

d. Timed presentations. The temporal order of the display can be a surprisingly effective means of cuing learners to important content elements. Graphic overlays and timed display of text can draw the learner's attention to appropriate detail while the basic frame remains the same. Properly used, timed presentations can introduce a small sense of drama and revelation to the CBI lesson.

5. Use verbal synthesizers, such as analogies, stories, and advance organizers to relate content to familiar experience. Placing unfamiliar content into a familiar context through a simple story or analogy can be both enlightening and motivating to learners (Curtis & Reigeluth, 1984). From a schema-theoretic

viewpoint, creating links of meaning between new material and existing learner knowledge makes the new material more easily recalled and more useful when it is recalled. Often, a short story or parable can effectively inform a learner of the lesson's objective without the need of a direct statement of objectives in abstract terms.

6. Provide integrated practice and other opportunities allowing the application of multiple skills to complex problems. The typical tutorial breaks down content into small chunks, completing each chunk with a practice problem or two, proceeding serially through a great deal of material. Too often, there is little cumulative learning, that is, learning based on prior learning. This problem can be partially addressed by making special efforts to allow for "integrated practice" requiring the learner to use knowledge and skills from a number of chunks in its solution. The integrated practice can take the form of a "mini-simulation" if the subject matter allows. This notion is somewhat related to Bunderson's "work models", in which increasingly detailed practice environments are provided to the learner (Bunderson, Gibbons, Olsen, & Kearsley, 1981).

Research on CBI Strategies

Although we make reference to literature in cognitive psychology, this paper is far from a psychology paper. Nor is it directly aimed at practicing instructional designers. Its audience can be termed "instructional researchers", whose research commitment lies somewhere between psychology and educational practice.

In 1961, Arthur Lumsdaine first talked about a "science of instruction":

> There is an important "middle ground" between a basic science of learning and an applied technology of educational method.... In view of the complexity of human learning, we can reasonably expect to find few universal generalizations that would hold for all classes of instructional objectives, all classes of learners, and all conditions of instruction. Rather, it seems evident that what is needed...is a series of contingent generalizations which take account of the interactions of variables... (Lumsdaine, 1961, pp. 497, 499)

This "science of instruction" has been advocated by many others (e.g., Simon, 1969, 1980; Reigeluth, Bunderson, & Merrill, 1978; Glaser, 1976), and it seems to include these features:

1. a commitment to developing prescriptive principles of the form "If you want A and you're in situation B, then do C."

2. a commitment to empirical validation of these contingent principles.

3. a commitment to economy or parsimony of theory, to maintain its utility to the practicing instructional designer.

What methods should instructional scientists employ in developing a knowledge base? Lumsdaine (1961) recommends as a research strategy several phases of factorial experimentation, with each phase building on the lessons learned of the former. We would add that experimental research must itself be balanced with careful model-building, hands-on tryout by practicing designers, and borrowing of existing methods that have stood the test of time (MacDonald-Ross, 1978, 1979).

Research in CBI strategies is almost an ideal setting in which to test developing instructional theories. Because of the highly controlled nature of CBI, and because of its flexible data-gathering capacity, strategies can be systematically examined and evaluated. The product of such research may not be a single comprehensive system of principles, but instead a rather disjointed set of guidelines and rules applicable in limited contexts. In any case, instructional researchers will be able to provide some much-needed guidance to practicing designers who are presently working feverishly to bring products to market.

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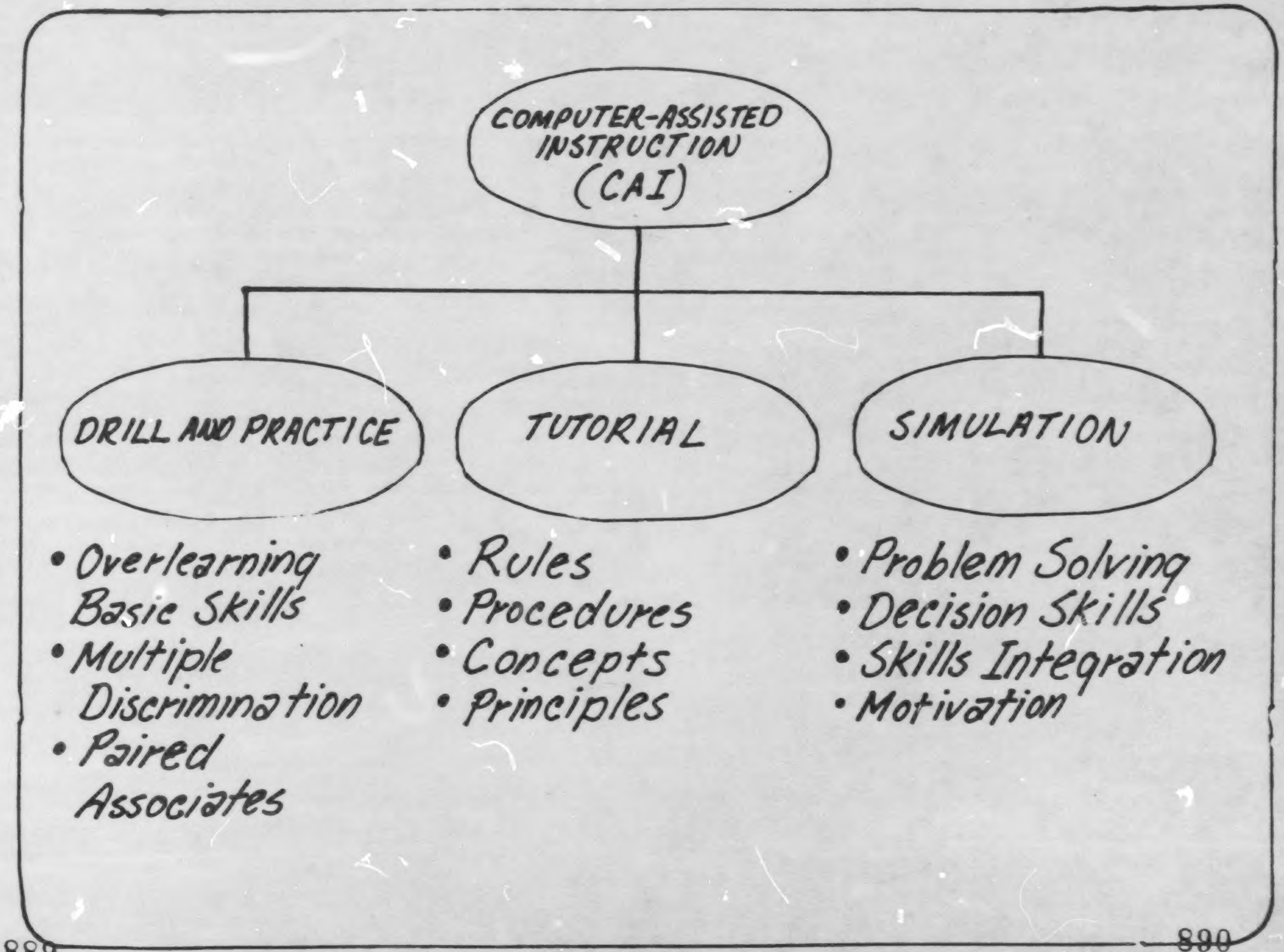

COMPUTER-ASSISTED INSTRUCTION (CAI)

DRILL AND PRACTICE

- Overlearning Basic Skills
- Multiple Discrimination
- Paired Associates

TUTORIAL

- Rules
- Procedures
- Concepts
- Principles

SIMULATION

- Problem Solving
- Decision Skills
- Skills Integration
- Motivation

Figure Caption

Figure 1. Tree diagram showing content structure for use as an adjunct aid to a CBI lesson.

ELECTRONIC BOOKS:
TOWARDS A THEORETICAL FRAMEWORK FOR RESEARCH

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Abstract

In an increasingly technological society there is a social need for designing communication technology around the perceptual abilities and cognitive strategies of people. Growing information demand has created additional pressure on emerging communication technologies to provide electronic alternatives to the printed page. As prose is still the most widely used method of educational communication, theory should converge on issues affecting readers of both the printed page and the electronic display. In developing electronic books there is need for a system within which research may examine relationships between textual material, communication technologies, and the psychology of readers.

Introduction

A new technology of communication is being created which should stretch beyond printed paper. Design depends on contributions from engineering and computer science, experimental and applied psychology and graphic art and typography (see Figure 1). Underlying the varying positions is one common pretheoretical assumption: reading of electronic text may be influenced by characteristics of its visual presentation.

The electronic book may not only replace much of what would have been printed, but stands by the side of what has been printed and eventually comes into being as its own authentic communication medium. Beyond the economic pressures to evolve, the electronic book may offer authors new ways of conveying meaning. It may allow readers new control of text by organization similar to database structure. This would be the ultimate goal: to eliminate impediments which designers place between authors and readers. There will no longer need be a silent intrusion by the technology of text (Yeaman, 1984).

The features of a theoretical framework for research on the electronic book are the reading environment, the relationship between the author and the reader, the readability of the text, its characteristics as a visual medium and the reading level of the reader. The most reliable and valid measures of reading efficiency are listed in the center of Figure 1. This paper focuses on the determination of legibility, towards examining the relationships between engineering, psychology, the graphic arts and education in contributing to the development of the electronic book.

Screen Reading Technology

The long and close viewing of electronic display screens is no longer the rare occurrence it once was when the initial applications were in the military, in navigation and in air traffic control. Such displays are currently supplanting the printed page and the predominant viewing task has changed from character recognition and identification to word processing and reading (Cohen & Carlson, 1980). The increase in CRT use in particular has raised concern about personal health by labor and government agencies in a number of countries. Potential hazards investigated so far include radiation emission, airborn chemical contamination, workstation dimension, reflective glare and psychological distress (Rupp, 1981).

The engineering standards for the transmission of high quality images come from broadcast television (Cohen & Calson, 1980). The major criterion is resolving power for fine detail (Snyder, 1973). Gould (1968) refers to the 1941 FCC decision that television should equal 16mm movies in average condition and show 200,000 half-tone dots.

Display engineers claim to have accounted for legibility with objective measures intended to evaluate the alphanumeric quality of CRTs for their earlier uses. Sherr (1979) operationalized legibility for engineers as the quantity of correct identifications made by the display's readers. Laboratory testing with human subjects has resulted in prescriptions for minimum character height (Shurtleff, 1980).

However, through the use of instruments generating and evaluating sine waves, observations are most commonly made independent of direct psychophysiological consideration. Human judgement is not required at all. Sherr (1979) considers this to be objective whereas human observation is undesirably subjective. Though conceding the attractiveness of psychometric techniques, he claims sufficiency would require excessively costly and time-consuming total system simulation.

The measure preferred by engineers to estimate human visual performance is called the modulation transfer function (MTF).

The display resolution is analyzed with a sine wave test signal (Biberman, 1973). Sine wave response across a CRT spot is moderated by changes in beam current, focus and off-axis conditions and is described by an algebraic equation of harmonics known as a Fourier transform (Sherr, 1979). The only human element in the equation is normal visual acuity taken as 50% detection probability with approximately 230 lines per inch displayed at 100ft-Lamberts viewed from 25 inches and an angle of 1 minute of arc. In MTF equations normal acuity is assumed and given a standard value of one (Biberman, 1973). Banbury (1982) describes this machine model of human perception as the golden eye. While human vision and screen parameters may be discussed in common terms by looking at spatial frequency variation, MTF applies to picture recognition much better than it does to the recognition of dot matrix alphanumerics (Rogowitz, 1983).

Cakir, Hart and Stewart (1980) warn their readers about the minimal testing of display legibility with human subjects. When it does take place, reading performance is usually quantified as accuracy of recognition of letters or single words; whether or not B is clearly distinguishable from R, S and 8. The variables in such a visibility test may be distance, character size and style or brightness and spacing. Procedures for such testing are spelled out by Shurtleff (1980).

Reading Psychology

Reading performance as a psychological construct is based on the task of reading, and the preferred geometry or photometry of single letters does not provide a base for judging legibility as a measure of reading. A link with ergonomics research on television and radar viewing may not be applicable to reading text from electronic displays because the task is different, i.e. distinction of fine detail does not guarantee legibility. For instance, dot-matrix letters, like the ones on this page, resemble the spots of color in a pointillist painting which require blending by the viewer's eye. Dot matrix characters can be read when sufficient detail is lost that the image of continuous strokes is seen. Enough detail must remain so that individual letters are not confused. Air traffic controllers learn to recognize special alphanumerics with a high discrimination and a low confusion rate between characters. The nature of their task differs from the one accomplished by readers of this sentence.

The advantage of extracting meaning by reading words over identifying individual letters is well established in reading psychology and was first demonstrated by Cattell who used a special flash card apparatus (1885). Single letters were named more slowly than short words and identification time for words was not proportionate to their length. This finding has been replicated many times in subsequent research on reading but its meaning is still debated (Dunn-Rankin, 1978; Wright, 1980).

Contrary to the engineer's point of view, text legibility involves the complexities of reading and is a cognitive issue. Thus, perceptual factors do not encompass all of the human factors involved in reading from CRTs. From the visibility of text it cannot be inferred that the text is acceptable to read without strain (Tinker, 1966).

Empirical Studies in Typography

Typographic research shows text legibility decreases when empirically based type conventions are disregarded. Letter size, line length and interline spacing are the major variables associated with lower comprehension, slower reading speed and inefficient eye movements (Tinker, 1965). The technology of electronically displayed text requires substantiation similar to that for printed text (Yeaman, 1984).

A contemporary paradigm for typographical research has been assembled by Bell and Sullivan (1981): "A cognitive/affective change occurs in a reader when personality/interest/reading style etc. characteristics encounter the imperative/recreational/advisory purpose of the material" (p. 57). It also may be defined as the ergonomic study of visually presented information displays (Foster, 1973).

Applications

The efforts of graphic designers towards developing screen formats for text have concentrated on data entry (Galitz, 1982), videotex and teletext (Reynolds, 1979, 1982) or interactive videodisc (Bork, 1981; DeBloois, 1982). Their typographic principles stem from the rational foundations of programmed learning texts: spacing for emphasis, color coding to convey meaning, short paragraphs to prevent intimidation of the students and so on. Aesthetic preferences are also a factor.

Instructional Technology

Jonassen (1982) states the purpose of the technology of text is to focus "on how written discourse can be most effectively presented" (p. ix), whether on the printed page or the electronic display screen. It is the "application of a scientific approach to text design" (p. x) and is rooted in the paradigm of instructional technology (Heinich, 1970). Implicit techniques relate to the organization of content as ideas. Explicit techniques such as advance organizers or graphic signals provide external indication of the text structure. These ideas do not extend beyond directly instructional purposes to encompass more general reading.

Synthesis

From the standpoint of theory building, Roufs and Bouma (1980) present a working philosophy. Both hardware engineers and visual researchers need to examine the connection between the characteristics of the observer and the visual image requirements in order to assure that the display peforms its function properly. Though technical and economic pressures cause display design choices to be made hastily, cooperation between the two groups would be of benefit. This joint endeavor would further vision theory and solve practical problems such as assessing the reader's ability and nature of the task, both previously neglected. Considerable international interest in this area has been shown recently by two conferences on Processing of Visible Language (Kolers, Wrolstad & Bouma, 1979, 1980) but interdisciplinary research remains rare.

Conclusion

Books of printed paper developed over a period of hundreds of years. All manner of corrections have been attempted in printed book design and production to develop a psychophysical fit in answer to empirical, rational and intuitive questions weighted against aesthetic and economic factors. There is not time for trial and error development of the electronic book. An effort must be made to build cognizance in special consumer research communities, such as education, that reading of text displayed on screens requires attention to technological/psychological problems which may otherwise be neglected.

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neurophysiology

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psychophysiological
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comprehension
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Figure 1: A viewfinder for developing electronic books.

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